

**Innovations in Pest Management:
Re-vegetation for Weed
and Pest Control**

**Pest Management Grants Final Report
Contract No. 97-0236**

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DISCLAIMER

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Department of Pesticide Regulation. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

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This project was implemented with grants from the Department of Pesticide Regulation in conjunction with ongoing work initiated and funded beginning in 1994-5 by the Friant Water Users Authority and its member Districts. Throughout the grant period partners on this project have included the Friant Water Users Authority, the Tulare County Farm Bureau, the U.S. Bureau of Reclamation, the Department of Fish and Game, the Visalia Office of the Cooperative Extension Service of the University of California, Davis, and the Department of Pesticide Regulation.

In addition, during 1998-9 five additional cooperators joined the project. These include the Arvin-Edison Water Storage District, Arvin—Kern County; Bidart Brothers, Bakersfield—Kern County; the Deer Creek and Tule River Water Authority and its Deer Creek ground water recharge basin enhancement partners, Woodville—Tulare County; Harlan Ranches, Fresno County; and Sharp Farms and Ranches, Tulare—Tulare County.

Thanks and appreciation must go to the numerous individuals, including researchers, growers, regulatory personnel, technical assistance professionals, water district managers, maintenance and field operations, university professors and students. These people provided comments, assistance and participated in the project, attended the workshops, received the project brochure, or are initiating similar efforts. Rapid exchange of ideas and new information is important in this endeavor and has been enabled through this process established by the Department of Pesticide Regulation.

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ABSTRACT

The Friant Water Users Authority initiated field research in 1994 to evaluate revegetating to minimize chemical weed and pest control, reduce erosion, and concomitantly their canal maintenance cost on the Friant-Kern Canal. In conjunction with grants from the California Department of Pesticide Regulation, partnerships were established among several regional government agencies, local farm bureaus, the UC Davis Cooperative Extension Service, water districts and growers to initiate a series of Revegetation trials. Numerous native perennial and two naturalized annual species of grasses, forbs and shrubs were tested. Qualitative germination and establishment of individual species and quantitative evaluations were made of planted seed mixes for cover, shrub densities, and ground squirrel burrows.

Needle-and-thread grass was the most successful individual species evaluated, while creeping wild rye, Indian ricegrass, Arizona brome and meadow barley also indicated strong results. Of the shrubs tested, California buckwheat, bladderpod and desert saltbush were all successful. Goldenbush and winterfat failed to produce viable stands.

Trends of plant cover and density of species increased on most plots, while invasive weeds decreased. These trends were the most obvious in the fourth growing season. Squirrel burrows all but disappeared from most planted sites or burrow densities remained low on all except one site.

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EXECUTIVE SUMMARY

The Friant Water Users Authority (FWUA), representing 25 water and irrigation districts comprised of over 12,000 growers, formed an alliance with the California Department of Fish and Game, Tulare County Farm Bureau, the University of California Cooperative Extension Service, and the U.S. Bureau of Reclamation. The purpose of the partnership was to evaluate and implement the use of revegetation to both help reduce chemical herbicide and pesticide use, and stabilize canal banks, levees, and other typically barren facility and adjacent areas. This work was first initiated by FWUA in 1994, prior to the development of the partnership with the Department of Pesticide Regulation's (DPR) Grant Program. Establishment of the partnership alliance helped garner broad-based support and interest in developing and expanding the process, both from research and demonstration aspects. A series of test-plots were established on the Friant-Kern Canal from Fresno to Bakersfield, California, spanning 150 miles of soil and climatic variability.

The project developed from a single series of test-plots at the beginning, to a broad-based partnership. The exciting findings led to the participation this year of several growers, a water district and another water authority. This grant period was spent in additional field data collection, design and the development of these demonstration test-plots and workshop planning. Work continued on the field vegetation sampling and data analyses.

The goals of this Phase (III) of the program were to:

- 1) Draft and distribute an analysis of long-term results which can practically be applied by anyone;
- 2) Complete a quantitative analysis of the plots to incorporate that data into the existing analyses;
- 3) Establish five outreach partner demonstration projects as agreed upon with Bidart Brothers, Harlan Ranch, Sharp Farms and Ranches, Deer Creek Tule River Authority and Arvin-Edison Water Storage District;
- 4) Conduct public workshop discussions of results, applications and benefits;
- 5) Conduct preliminary qualitative vegetation and insect monitoring and evaluation of the five new demonstration projects; and
- 6) Develop recommended planting guidelines for public distribution.

EXECUTIVE SUMMARY (continued)

The demonstration sites were planted with seed mixes selected in accordance with previously successful planting techniques. Large flat areas were drill-seeded, and slopes and difficult-to-access sites were hydroseeded. Two tons per acre of rice straw mulch were either crimped or tacked on each site, with the exception of the orchard planting, where mulching equipment could not fit.

The sites were sampled in the spring of 1998 and a qualitative evaluation was completed for the newly planted sites. Random transects sampled herbaceous vegetative cover and shrub cover was sampled by line intercept. Complete shrub density counts were done for each plot with shrubs. Because the season was so cold and late in 1999, insect evaluations could not be done prior to this report for the newly planted sites.

On all the sites, needle-and-thread grass was the most successful individual species evaluated, while creeping wild rye, Indian ricegrass, Arizona brome, and meadow barley also indicated strong results. Of the shrubs tested, California buckwheat, bladderpod and desert saltbush were all successful. Goldenbush and winterfat failed to produce viable stands. All the lupines were highly successful. Yarrow appeared to be establishing on the more mesic sites. Although it was too soon to determine, it appeared that planting native early successional species, such as lupines, may help control exotic annual weed competition.

Trends of plant cover and density of species increased on most plots, while invasive weeds decreased. These trends were the most obvious in the fourth growing season. Squirrel densities were either gone or remained low on all except one site.

Practical problems of unauthorized trespass, herbicide spraying and driving on the plots, either with vehicles or other farm equipment, were identified during the field evaluations. To minimize economic losses, these types of issues need to be addressed during the planning and implementation process for anyone attempting this type of work.

General site stabilization and planting guidelines were summarized for assistance to those interested in pursuing revegetation for weed and pest control. These same principles would also apply to roadside edges and other typically ruderal sites on farms and ranches and adjacent to industrial developments.

1.0 INTRODUCTION

This project was conceptualized for a variety of reasons. Mechanical and chemical disturbance over time along Valley waterways has created and maintained suitable habitat for the invasion of both noxious weeds and wildlife pests. Some wildland pests included raven, blackbird, starling, coyote, agronomically deleterious insects, and ground squirrels. Noxious or pervasive weeds included yellow starthistle, milk thistle, puncturevine, Russian thistle and other species. Waste materials dumped alongside canals, such as broken concrete, contributed to the creation of a wildlife pest habitat. Bare ground associated with prolonged use of soil sterilant herbicides along embankments created uncontrolled erosion off canal banks and eliminated healthy insect diversity. From extensive field observations, it appeared that absence of vegetation correlated with increased levels of wildlife pests, injurious insects and many types of weeds, including noxious species. Over time, certain weeds were found to have developed a resistance to herbicides, consequently dominating vegetative cover in some areas. Solutions proposed to address these problems and symptoms of land use were coupled with requirements of the Friant long-term and short-term contract Biological Opinions. FWUA formulated management and maintenance goals to reduce maintenance costs, reduce erosion and beneficially enhance diversity of insects and wildlife along the canal and its related facilities. The decision was made to evaluate the ability of native and naturalized plant species to help reduce or eliminate use of chemical weed and pest control, ultimately reducing overall costs, while not having an adverse impact on adjacent agricultural fields.

2.0 MATERIALS AND METHODS

Analyses of plots were executed on both qualitative and quantitative levels. Qualitative observations were done at individual species test plots to assess germination, population establishment, vitality and vigor. Other considerations were assessed for percent cover class, weed profusion and other notable sightings

Quantitative analyses were executed using two methods. Method I: Counts were done for shrubs and ground squirrel burrows. Method II: Line transect-intercepts were randomly laid at seven areas on each site. The line intercept was 100' in length and all vegetation touching the line was identified and calculated including bare ground, litter, moss, and rock in order to include 100% of the transect area. Data was statistically analyzed and are presented in Appendices 1 and 4.

Insect evaluations were not executed in 1999 prior to writing of this report. This was due to the slow establishment of plants caused by long periods of low growing temperature degree days caused by a very cold winter and late seasonal rainfall, resulting in poor presence of insect populations.

2.1 1994-5 and 1996-7 Mixed Species Plots

Fourteen original sites for revegetation were chosen in 1994, stretching an expanse of 150 miles from Bakersfield to Fresno County along the Friant-Kern canal. These study plots were established prior to the DPR grant. All plots were prepared by first grading off the weeds and vegetation, followed by ripping and disking. Seed mixes were developed based on suitability to the site, commercial availability and price constraints. Mixes contained native perennial grasses, naturalized grasses, native forbs and native shrubs. The sites were not irrigated hence, seeding was done prior to, or during the rainy season. Use of perennial seeds was preferred because it has been proven these long-lived plants contribute to more plant cover overall, provide more effective erosion control, are less susceptible to wildfire and provide year-round wildlife habitat and forage. Two naturalized annual grasses were also evaluated.

Seed was drilled at flat sites and hydroseeded on slopes. All sites initially utilized wheat straw mulch which proved to be competitive because of high rainfalls which enabled it to germinate. Rice straw was chosen thereafter, and this change eliminated growth competitiveness from the mulch.

Another fifteen species and three mixes were planted at five additional sites in the fall of 1996. One site, Avenue 48/52, was selected specifically to address an existing large ground squirrel population by establishment of permanent vegetation. They were planted by the same methods described above, with the exception that 1994-5 and 1996-7 Mixed Species Plots rice straw was used instead of wheat straw.

2.2 1998-9 Five New Demonstration Cooperator Test Plots

Part of the project involved public outreach and education. As growers and water districts took field tours to the sites and learned about the work, some expressed an interest in implementing revegetation strategies on their own lands. In 1998/9, another five sites in collaboration with grower/cooperators were established in the fall 1998 (Appendix 2). These plots also afforded an expanded variety of growing conditions other than the 14 original canal sites (Appendix 3). Arvin-Edison was located at FWUA recharge basin pond embankments on the Valley floor at the base of Tehachapi Mountains. Bidart Farms hosted weed-infested fencelines on row crop land adjacent to the canal. Deer Creek was FWUA flat land found in wet low lying areas. Harlan Ranches had fenceline and flat land plots in the Sierra lowland area due east of Clovis. Sharp Farms afforded the project opportunities for revegetation of both sump slopes and an orchard floor.

2.3 Public Outreach

Use of the Friant Waterline (the monthly journal pertaining to FWUA news and projects), press releases, public speaking and distribution of our DPR Revegetation for Weed and Pest Control brochures were implemented to help ensure public outreach and education. Some projects, such as Deer Creek, were noted in articles in the regional press (see the Interim Report, September 1998).

3.0 RESULTS

Field sampling for both qualitative and quantitative data were initiated in the spring and completed in the early summer of 1998. Numerous late spring and summer rainfall events interfered with sampling field work. Again, historically unprecedented high precipitation had an adverse effect on various plant and wildlife species, and appeared to generate accelerated growth of introduced species. During the winter of 1998-9, historical record setting periods of very low temperatures were experienced, including four to six inches of snow which remained on the ground for one or two days, depending upon location. Temperatures remained low through March, greatly slowing the germination and growth of many species. Prior to the qualitative evaluation in March 1999, many plants, including the warm season species on the cooperator plots had not germinated.

3.1 Results of Vegetation Test Plot Sampling

3.1.1 1994-5 and 1996-7 Mixed Species Plots

A number of plots planted with seed mixes were not sampled for various reasons. One plot, Orosi, was not quantitatively sampled after the first year due to poor plant establishment, because of a profusion of six-foot tall mustard, and a large snake population. However, the site was mowed for the past two years and it is being qualitatively monitored to determine if that is an effective technique for restoring sites damaged by weed competition. In the Midwest, prairie meadow vegetation in old cemeteries has been found to be released by burning, so this is a possibility as the seed is still present. Both mix plots at Alta were given up after the second evaluation season due to a combination of poor growth (except for a fair stand of needlegrass) caused by extensive weed competition and an accidental burn. Four damaged plots were not surveyed in 1998. American Avenue North was extensively damaged during the wet winter of 1998 by deep rutting caused by tractor wheel disturbance.

Growth of the mixes and individual species in the 1994-95 planted plots continued to indicate best species for sandy loam soils. The mixes on sandy loam soils did well. Although a number of introduced alien species persisted in these plots, the sites appeared stable and continued to resist invasion by noxious weeds. Species data are presented in Appendix 4 with photographs in Appendix 5.

Recommendations for heavier soils were difficult to make. Based on preliminary evidence, many of the perennial grasses were less successful on these soils. However, the lupines in particular, did well, as did the yarrow. This was demonstrated by the initial success on the mix plots near the St. Johns River. Unfortunately, most of this plot was destroyed by third party heavy equipment during pumping activities to control flood waters late spring 1998.

Insect monitoring results showed in 1998 plantings increased the diversity of insects, favoring beneficial rather than pest insects. Beneficial insects were also encountered well into adjacent vineyards where they are not normally encountered (Jimenez, personal communication).

In the established plots where line transect analyses were conducted, overall trend for success of revegetation revealed positive results. Most impressive was a reduction of pervasive weeds at all plots with an average decrease 1994-5 and 1996-7 Mixed Species Plots these species by 82%.

Native species increased by an average of 173% at all plots except Coffee West. Native grass populations were again not found at Coffee East or Rocky Hill, as anticipated because these are unseeded sites. They declined at American Avenue South, Deer Creek 1, Lerdo Non-op and Shafter E/W but increased at the remaining seven plots for an average of 206%. The ratio of native plants to: annual weed cover increased by 11% exhibiting an overall trend of out-competition by the natives to the annual exotic species.

Shrub growth averaged a 188% increase at nine plots. Consistent with past surveys no shrubs were noted at Lerdo Wet or Rocky Hill. No shrubs were planted at either of these sites. A mix of grasses adapted to wet areas was planted at the low Lerdo site. Rocky Hill is the second of two unplanted natural succession sites. The most consistent increase by species was with California buckwheat which was established at 80% of all sites. Saltbush increased at all but two sites and remained in viable numbers. Bladderpod was successfully established at both Lerdo sites. A volunteer nicotine tree was noted at Deer Creek 2. Two individual black cottonwoods were established as volunteers at Lerdo Wet. Five sites showed a decrease in forbs but 8 sites increased with an average of 43%. Grass population trends were similar with 4 sites showing a decrease, and 9 sites increasing, with an overall average of 52%.

Total plant cover increased at 85% of sites with only a slight decrease at Coffee West, a natural succession site, and Deer Creek 2. Many plots showed plant cover percentage above 100% due to increased canopy cover from shrubs shrouding the herbaceous species underneath. The data reflect both an increase in species diversity and complexity of vegetation.

3.1.2 Individual Species Test Plots

All individual species plots were sampled annually for four years, regardless of site condition (Appendix 6). Qualitative analysis of individual species test-plots showed a variation of success rates for plants. Native perennial grass establishment varied by test plot. The least success was found at Alta North with only needle-and-thread grass growing out of the ten species planted. Alta South also exhibited weak stands although 50% of species planted grew. Eighty percent of species germinated at Orosi with no saltgrass or Indian ricegrass found, but stands were weak. Individual Species Test Plots American Avenue had slightly stronger populations still lacking saltgrass, Indian ricegrass, and Mediterranean grass. Deer Creek and Shafter Check showed fair to strong populations but no saltgrass or squirreltail. The most successful plots were at Shafter Check West where all ten species germinated and appeared established but did not persist.

The most strongly established grasses were Indian ricegrass, needle-and-thread grass, foxtail fescue and creeping wild rye. Other plant populations that were successfully established in the 1996-7 plots were; Arizona brome, meadow barley, and prairie junegrass.

Shrubs established best on the Lerdo, Shafter Check and Deer Creek plot sites (Appendix 7). There was a poor stand at Orosi and fair stands at both American Avenue plots. Establishment of shrubs at Deer Creek was greatest overall with a high count of 849 plants/plot versus an overall average in all Deer Creek plots of 330/plot. California buckwheat established with an average of 13 plants/plot. Shrubs appear to be type of plant most responsible for attracting the largest number of beneficial insects to the sites, as reflected in previous reports. They also create a positive plant life form diversity, important for many wildlife species, including birds that are also beneficial for insect control.

3.1.3 Ground Squirrel Monitoring

No ground squirrels were found at the Lerdo wet site or slopes. After three years, only a single squirrel burrow was counted at the four Shafter Check test plots (Appendix 8).

Ground squirrels were found at the three Deer Creek plots in addition to the Avenue 48/52 sites. An average of 12 burrows/site were counted. Ground squirrel activity was predominant at Avenue 48/52 with an average of 52 burrows/plot. This site historically had severe problems with rodent populations especially on the east side of the canal from adjacent orchards. An aggressive bait station program was implemented to control this dilemma in conjunction with revegetation efforts. The lack of plant cover at these plots was consistent with management theory that ground squirrels inhabit disturbed open spaces that lack significant plant cover.

3.2 Five New Cooperator Demonstration Plots

Because the five new demonstration-plots were planted in the unusually cold fall of 1998, germination on all sites was delayed. The Southern San Joaquin Valley had average precipitation but the northern end of the Valley received only a little more than 50% of normal. For these reasons the qualitative evaluation was done in late March to allow for as much growth as possible. The sites will continue to be monitored throughout the growing season (Appendix 9).

3.2.1 Arvin Edison Water Storage District

Arvin Edison was seeded with wetland species for inside pond bank erosion control. Established ponds still experienced significant wave wash bank degradation because vegetation did not seem to establish itself naturally in these areas. This created constant erosion and an ongoing maintenance problem. Soon after planting the water level was elevated and wave action washed away 3 of 4 slopes. A single lupine was identified to have germinated. Weed competition was not an issue. Although Arvin experienced its coldest winter in 100 years, germination could have been delayed although the temperature should not have affected the perennial species. Documentation at Arvin showed dry land species successfully grew there.

3.2.2 Bidart Farms Fenceline Plots

Bidart Farms (adjacent to Shafter Check and Lerdo) was planted in 1998 only with grasses along the fenceline in order to establish a population which would out-compete noxious weeds. Unfortunately a 10-foot space had been left between the fence and plots for maintenance vehicle access. By evaluations in March 1999, numerous weeds were emerging with a germination rate of the seeded grass species being nominal. Due to predominance of an established noxious population, this was anticipated. However, based on previous work, most of the weeds will be out-competed within 3 years. At the Lerdo site, creeping wild rye was the first sown grass to germinate. Unfortunately, fenceline plants at this location showed damage from inadvertent spraying and will likely die-back from apparent herbicide application visible in the photograph as the pink tint on the soil surface.

3.2.3 Deer Creek and Tule River Authority at Deer Creek.

A mix of mesic grasses and shrubs were planted between pond and canal Deer Creek and Tule River Authority at Deer Creek levees at Deer Creek for both reduction of pest insects, ground squirrels and habitat enhancement. The area was flooded in February when a small levee broke along Deer Creek.

However, field evaluation indicated that germination was initiated. Again, the lupines were the first species to be observed germinating. Two *acaera* moths, typical of marshes, were noted on the site. Although some Johnsongrass was germinating on the site, it was not a competitive problem. Because of the cold nights and late winter, establishment this year was also noted to be very slow on this site.

3.2.4 Harlan Ranches

Harlan Ranches showed excellent germination of lupine and fair of purple owls clover. Other species, especially grasses, either had not germinated or were too immature to identify during the evaluation. Evidence suggests this planting will develop at the site. Germination of foxtail barley, mustard, and yellow starthistle was evident. Vetch, not included in the seed mix, was well established with 100% cover in two small areas. Albeit soil preparation at the second site near a pond was poor, lupines and purple owls clover germinated successfully despite extensive grazing by waterfowl. Residual herbicide run-off was noted from the orange grove onto one of the plots which probably affected the native grasses in the seed mix. However, the live plant material left in the furrows will likely create a competitive disadvantage for the slowly germinating native species that were seeded.

3.2.5 Sharp Farms and Ranches

At Sharp Farms and Ranches only lupine and purple owls clover had germinated on the sumps by the time the evaluation was conducted in March 1999. Cheeseweed, lambs quarters, and riggut brome were strongly evident on slopes and seeded grasses had yet to germinate. Slope preparation by the cooperator proved to be the malefactor in that other slope areas with good mulching and removal of residual weedy material hosted fewer weedy species. In the orchard, competitive amounts of riggut brome had germinated.

3.3 Public Outreach

Various presentations, such as at the Natural Communities Conference in Bakersfield in 1998, were volunteered and provided upon request. Talks were given at Monache High School, and work from this project was integrated into a habitat enhancement partnership at Deer Creek by the Deer Creek and Tule River Authority (Appendix 10).

3.3.1 Farms and Ranches Workshop Participation

Project results from data collection of previous years, coupled with experiences from this DPR project, were given at the Wildlife Society's broad spectrum public workshop in December 1998, entitled "Practical Applications of Habitat and Wildlife Management on Farms and Ranches". FWUA helped sponsor this project as it appeared that this workshop would help generate additional opportunities to reach a wider audience with the findings and experiences garnered through the implementation of these studies. Presentations given by project participants with respect to the DPR revegetation for weed and pest control study were:

1. "Practical political and policy parameters for habitat management partnerships in the Central Valley." (Richard M. Moss - Manager, Friant Water Users Authority, presenter)
2. "Native species trials for revegetation on canal levees." (Marcia Wolfe, presenter)
3. "Revegetation for weed and pest control." (Julie Clark, presenter)

A poster exhibit was displayed illustrating the seeding methods this project has used for successful revegetation. Deborah Jackson staffed the exhibits during the conference. In addition, a poster exhibit on owl and raptor box construction was delivered regarding their use and effectiveness with establishment of stable vegetation communities around farms and ranches in areas that are typically clean-farmed. A live barn owl demonstration was also conducted, explaining their usefulness with rodent control and the importance of tree maintenance or revegetation for their natural habitat.

3.3.2 Planting Guidelines

A draft of general planting guidelines is included in Appendix 10. Methodologies of seeding native species successfully have been established at this point. Appropriate interpretation and application of techniques is essential for seeding large areas. Use of mulch is critical during dry and

3.3.2 Planting Guidelines (continued)

average years for moisture control, and perhaps is equally important in wet years, to help minimize exotic weed establishment. Proper selection of species is important. Growers need to be encouraged to collect and increase seed for those species which are valuable, but not yet economically available. Genetic work, especially for species with wide ranging ecotypes, such as the bluegrasses is essential. Hand collected local pine bluegrass could not be established in the Southern San Joaquin Valley, even though it grows in the low hillsides of the valley.

A critical element of seeding is site preparation. The experiences and guidelines being developed here are generally for areas which have been clean farmed and have a reduced weed seed bank. The techniques we evaluated will not be effective alone for habitat conversion, i.e., conversion from dense ruderal or non-native grassland. Habitat conversion will require seed bed manipulation, reduction through herbicide application and disking, and repeated fire or pre-irrigation disking.

4.0 DISCUSSION

Overall success of most of the undisturbed plots was high, with the exception of the three northern 1996-7 plots in heavy clay soils. Analyses of all sites surveyed showed markedly positive trends in all aspects of vegetation establishment. Pervasive weed populations declined, with native plant—annual weed ratio increasing by 11%. All plant cover categories showed improvement, with a 37% average increase in total cover, to an impressive average 206% incline in native grass populations.

Newly planted plots from 1998 showed relatively little germination and establishment. Response may have been phenological due to an abnormally cold winter and late rainy season. Evidence suggests a likelihood for viability and success before the dry season set in for 1999.

Based on our original predictions, results of the success of this project are now being realized. With growing interest of growers and cooperators, ultimate widespread success of this project is spreading throughout the region. We receive calls almost on a weekly basis requesting advice, recommendations and inquiring about other related issues from a wide sector of the public interested in some aspect of implementing similar revegetation or reducing chemical weed and pest control. University classes from Southern California have been annually touring the revegetated sites.

DISCUSSION (continued)

In several instances, excessive weed growth created a problem for seeded plant establishment, occurring mostly on areas which had extensive previous vegetation. However, many seeded areas lacking weedy growth competition as well failed to exhibit germination of new species. Since historical records of indigenous Valley floor species growing prior to habitation by European settlers are not well documented, the primary way to determine viable species is to test them. These trials were based on known native species and species found in similar habitats of other areas of California.

All lupine species were highly successful. Yarrow appeared to be establishing on the more mesic sites. Although it was too soon to determine, it appeared that planting native early successional species, such as lupines, may help control exotic annual weed competition.

Fencing or signage seem to have failed in effectiveness for protection of plantings. Signs of all kinds were widely ignored or destroyed. Installed fencing consisting of wire and posts was removed or stolen. Sites located between locked gates experienced damages, indicating that personnel with access were among those damaging the plots. New methods of managing these challenging issues are being evaluated.

Ground squirrels were not found on the majority of the test plots, some of which are a mile in length. On all plots except one densities of burrows were low. The finding from this singular location contradicts the belief that ground squirrels are more commonly found in disturbed areas without dense plant cover. Further evaluation and study would show if this site is an anomaly to the theory. A very high density of squirrels existed on this particular site prior to planting. It may be unlikely that seeding can eliminate squirrels from a site with a very high squirrel population density without prior chemical control. Based on observations from all the other plot locations, it appears if the squirrels are eliminated prior to planting, the established vegetation creates a habitat they do not prefer and prevents or minimizes their re-invasion of the site.

5.0 SUMMARY AND CONCLUSIONS

This long term ongoing study has documented positive results for the application of revegetation along waterways, fencelines, and ruderal areas. The outcome can be assessed by grouping assets into two broad-based categories.

Category I: Biodiversity of both plants and animals is increased. Success in establishment of plant populations of beneficial insects, native grasses, shrubs, and total vegetative cover resulted in substantially lower presence of invasive weeds and injurious insects on seeded plots.

Category II: Cost savings over time can be realized to the cooperator. Herbicide and soil sterilant use can be minimized, if not completely eliminated. Costs associated with erosion and wildland pest controls are considerably lowered. Related labor charges are curbed along with material costs. Aesthetic and ensuing real estate values are as well enhanced by the increase in plant and wildlife biodiversity. Most significantly, this project has initiated fostering of an atmosphere of community and cooperation of neighbors, agencies, and growers in an effort to plan, and execute broad-based guidelines and cultural practices for improving the land and environment. These conclusions have been substantiated by the following findings:

- ! Planting formerly sterilized areas with a seed mix that was successfully established reduced or eliminated the need for weed control over time.
- ! Seeded vegetation reduced or maintained rodent burrow densities at a low level on all planted sites but one. A stable vegetation cover can be used to discourage squirrel invasion, but planting alone cannot eliminate existing high densities.
- ! Planting native species increased insect biodiversity on all sites sampled. The healthy level of multifunctionality prevents the sites from becoming sources for pest insects. Beneficial insects originating from sampling sites were found to have established well into adjacent agricultural fields.
- ! Successful plantings essentially eliminated rill and gully erosion on slopes except where drainage engineering would be required.
- ! Establishment of planting mixes revealed that shrubs, grasses, and forbs can be successfully planted together at the same time.
- ! Twenty native grass species were evaluated. Of these, nine were established and persisted. Needle-and-thread (*Heterostipa comata*) in particular was highly successful on a wide variety of sites.
- ! One non-native naturalized taxon, *Vulpia myuros*, was successful in establishment on most sites.
- ! Four species of shrubs were evaluated. Of these, three (desert salt bush, bladderpod, and California buckwheat) proved successful in plantings on a variety of sites.
- ! Use of forbs, particularly lupines, appeared to help establishment by reducing competition of non-native annuals.

- ! On the successful sites, use of soil sterilant herbicides was no longer necessary in most cases.
- ! Maintenance and chemical applicator personnel need to be trained to recognize plots and plantings in an effort to preserve these sites.

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Appendix 1. Acronyms and information about plants sampled in test plots.

abbreviation AGNO
 genus
 species
 subspecies
 family
 common name eye
 other name agropyron
 type plant grass
 growth habit annual
 native? no
 indicator? no
 invasive?
 comments Not in this floristic province

abbreviation AMME
 genus *Amsickia*
 species *menziesii*
 subspecies *intermedia*
 family *Boraginaceae*
 common name coast fiddleneck
 other name amsickia
 type plant forb
 growth habit annual
 native? yes
 indicator? yes
 invasive? no
 comments

abbreviation AMAC
 genus *Ambrosia*
 species *acathicarpa*
 subspecies
 family *Asteraceae*
 common name annual bur sage
 other name
 type plant forb
 growth habit annual
 native? yes
 indicator? yes
 invasive? no
 comments

abbreviation AMRE
 genus *Amaranthus*
 species *retroflexus*
 subspecies
 family *Amaranthaceae*
 common name red root pigweed
 other name AMAR
 type plant forb
 growth habit annual
 native? no
 indicator? yes
 invasive? yes
 comments

abbreviation AMBR
 genus *Ambrosia*
 species spp.
 subspecies
 family *Asteraceae*
 common name ambrosia, ragweed
 other name ambrosia
 type plant forb
 growth habit annual
 native?
 indicator? yes
 invasive? no
 comments

abbreviation ARGL
 genus *Arabis*
 species *glabra*
 subspecies
 family *Brassicaceae*
 common name rock cress
 other name arabis
 type plant forb
 growth habit biennial
 native? yes
 indicator? no
 invasive? no
 comments

abbreviation ASSP
 genus *Asclepias*
 species *speciosa*
 subspecies
 family *Asclepiadaceae*
 common name Greek milkweed
 other name showy milkweed; asclepias
 type plant forb
 growth habit perennial
 native? yes
 indicator? no
 invasive? no
 comments

abbreviation ATPO
 genus *Atriplex*
 species *polycarpa*
 subspecies
 family *Chenopodiaceae*
 common name alkali saltbush
 other name
 type plant shrub
 growth habit perennial
 native? yes
 indicator?
 invasive? yes
 comments soil stabilizer

abbreviation
 genus
 species
 subspecies
 family
 common name
 other name
 type plant
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation
 genus
 species
 subspecies
 family
 common name
 other name
 type plant
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation ATSER
 genus *Atriplex*
 species *serenana*
 subspecies
 family *Chenopodiaceae*
 common name bradyscale saltbush
 other name
 type plant sub-shrub
 growth habit annual
 native? yes
 indicator? no
 invasive? no
 comments Deer Creek mix 3, 14, Matl

abbreviation AVSA
 genus *Avena*
 species *sativa*
 subspecies
 family *Poaceae*
 common name cultivated oats
 other name avena
 type plant grass
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation ATSP
 genus *Atriplex*
 species *spinifera*
 subspecies
 family *Chenopodiaceae*
 common name
 other name
 type plant shrub
 growth habit perennial
 native? yes
 indicator? no
 invasive? no
 comments

abbreviation AVSH
 genus
 species
 subspecies
 family
 common name
 other name
 type plant
 growth habit
 native?
 indicator?
 invasive?
 comments Lerdo wet 16

abbreviation AVFA
 genus *Avena*
 species *latua*
 subspecies
 family *Poaceae*
 common name wild oats
 other name avena
 type plant grass
 growth habit annual
 native? no
 indicator? no
 invasive? yes
 comments

abbreviation BAGR
 genus n/a
 species
 subspecies
 family
 common name bare ground
 other name br. grnd.
 type plant
 growth habit
 native?
 indicator? yes
 invasive?
 comments

abbreviation BRAS
 genus *Brassica*
 species spp.
 subspecies
 family *Brassicaceae*
 common name
 other name Brassica spp.
 type plant forb
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation BRNA
 genus *Brassica*
 species *napus*
 subspecies
 family *Brassicaceae*
 common name Swede rape, rapeseed
 other name nussard with long siliques
 type plant sub shrub
 growth habit annual/biennial
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation
 genus
 species
 subspecies
 family
 common name
 other name
 type plant
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation
 genus
 species
 subspecies
 family
 common name
 other name
 type plant
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation BRRI
 genus *Bromus*
 species *diandrus*
 subspecies
 family *Poaceae*
 common name rigid bromegrass
 other name *Bromus rigidus*, BRDI
 type plant grass
 growth habit annual
 native? no
 indicator? yes
 invasive? yes
 comments

abbreviation BRRI
 genus *Bromus*
 species *rigidus*
 subspecies
 family *Poaceae*
 common name rigid bromegrass
 other name *Bromus diandrus*, BRDI
 type plant grass
 growth habit annual
 native? no
 indicator? yes
 invasive? yes
 comments

abbreviation BRTE
 genus *Bromus*
 species *tectorum*
 subspecies
 family *Poaceae*
 common name cheatgrass
 other name downy brome
 type plant grass
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation CEGE
 genus *Cerastium*
 species *glomeratum*
 subspecies
 family *Caryophyllaceae*
 common name mouse-ear chickweed
 other name cerastium
 type plant forb
 growth habit annual
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation CESA
 genus *Centaurea*
 species *solstitialis*
 subspecies
 family *Asteraceae*
 common name yellow starthistle
 other name starthistle, STTH
 type plant forb/sub-shrub
 growth habit biennial
 native? no
 indicator? yes
 invasive? yes
 comments noxious

abbreviation CHAL
 genus *Chenopodium*
 species *album*
 subspecies
 family *Chenopodiaceae*
 common name lambsquarters
 other name
 type plant forb
 growth habit annual
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation BRIR
 genus *Bromus*
 species *trini*
 subspecies
 family *Poaceae*
 common name chloan chess
 other name Chloan brome
 type plant grass
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation CAEU
 genus *Capsella*
 species *bursa-pastoris*
 subspecies
 family *Brassicaceae*
 common name shepherd's purse
 other name capsella
 type plant forb
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation CAEX
 genus *Castilleja*
 species *exserta*
 subspecies *exserta*
 family *Scrophulariaceae*
 common name purple owl clover
 other name *orthocarpus purpureus*
 type plant forb
 growth habit annual
 native? yes
 indicator? yes
 invasive? no
 comments

abbreviation CHEN
 genus *Chenopodium*
 species spp.
 subspecies
 family *Chenopodium*
 common name pigweed, goosefoot
 other name Chenop.
 type plant forb
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation COAR
 genus *Convolvulus*
 species *arvensis*
 subspecies
 family *Convolvulaceae*
 common name bindweed, orchard morning
 other name convolvulus
 type plant forb
 growth habit perennial
 native? no
 indicator? yes
 invasive? yes
 comments

abbreviation CORO
 genus *Coryza*
 species *bonariensis*
 subspecies
 family *Asteraceae*
 common name hairy fleabane
 other name coryza
 type plant forb
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation COCA
 genus *Coryza*
 species *canadensis*
 subspecies
 family *Asteraceae*
 common name horseweed
 other name coryza
 type plant forb
 growth habit annual
 native? yes
 indicator? no
 invasive? no
 comments

abbreviation CONV
 genus *Convolvulus*
 species spp.
 subspecies
 family *Convolvulaceae*
 common name bindweed
 other name conv.
 type plant forb
 growth habit annual
 native? no
 indicator? no
 invasive? yes
 comments

abbreviation CONY
 genus *Coryza*
 species spp.
 subspecies
 family *Asteraceae*
 common name
 other name coryza
 type plant forb
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation DEPI
 genus *Descurainia*
 species *pinnata*
 subspecies
 family *Brassicaceae*
 common name fensy mustard
 other name descurainia
 type plant forb
 growth habit annual
 native? no
 indicator? yes
 invasive? yes
 comments

abbreviation DIIS
 genus *Digitaria*
 species *ischaemum*
 subspecies
 family *Poaceae*
 common name
 other name
 type plant grass
 growth habit annual
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation ECHI
 genus *Echinocystis*
 species spp.
 subspecies
 family *Poaceae*
 common name
 other name Echinocystis
 type plant grass
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments run mix. slope mix. wet n

abbreviation COSI
 genus *Convolvulus*
 species *simulans*
 subspecies
 family *Convolvulaceae*
 common name bindweed, orchard morning
 other name convolvulus
 type plant forb
 growth habit annual
 native? yes
 indicator? yes
 invasive? no
 comments

abbreviation CRCO
 genus *Crassula*
 species *connata*
 subspecies
 family *Crassulaceae*
 common name pygmy weed
 other name *Tillaea* or *crassula erecta*
 type plant forb
 growth habit annual
 native? yes
 indicator? no
 invasive? no
 comments

abbreviation CYDA
 genus *Cynodon*
 species *dactylon*
 subspecies
 family *Poaceae*
 common name Bermuda grass
 other name Bermuda
 type plant grass
 growth habit perennial
 native? no
 indicator? yes
 invasive? yes
 comments Toxic allergies & contact

abbreviation EPIL
 genus *Epiobium*
 species spp.
 subspecies
 family *Onagraceae*
 common name fireweed
 other name epiobium
 type plant forb
 growth habit annual
 native? yes
 indicator? no
 invasive? no
 comments n & s mix

abbreviation EPTO
 genus *Epiobium*
 species *torrey*
 subspecies
 family *Onagraceae*
 common name fireweed
 other name willow herb, fireweed
 type plant sub-shrub
 growth habit annual
 native? yes
 indicator? no
 invasive? no
 comments

abbreviation ERCI
 genus *Eriodum*
 species *cicutarium*
 subspecies
 family *Geraniaceae*
 common name red-stem filaree
 other name
 type plant forb
 growth habit annual
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation	ERFA	abbreviation	ERSE	abbreviation	EUMA	abbreviation	GALI	abbreviation	GLOC	abbreviation	GNAP
genus	<i>Erigonum</i>	genus	<i>Eriogonum</i>	genus	<i>Euphorbia</i>	genus	<i>Galium</i>	genus	<i>Glyceria</i>	genus	<i>Gnaphalium</i>
species	<i>fasciculatum</i>	species	<i>setigerum</i>	species	<i>maculata</i>	species	spp.	species	<i>occidentalis</i>	species	spp.
subspecies		subspecies		subspecies		subspecies		subspecies		subspecies	
family	<i>Polygonaceae</i>	family	<i>Euphorbiaceae</i>	family	<i>Euphorbiaceae</i>	family	<i>Rubiaceae</i>	family	<i>Poaceae</i>	family	<i>Asteraceae</i>
common name	California buckwheat	common name	dove weed, turkey mullein	common name	spotted spurge	common name	bedstraw	common name	manisgrass	common name	everlasting, cudweed
other name		other name	erionocarpus	other name	<i>Chamaesyce maculata</i>	other name		other name	glyceria	other name	gnaphalium
type plant	shrub	type plant	forb	type plant	forb	type plant	forb	type plant	grass	type plant	forb
growth habit	perennial	growth habit	annual	growth habit	annual	growth habit	annual	growth habit	annual	growth habit	annual
native?	yes	native?	yes	native?	no	native?	yes	native?	no	native?	no
indicator?	no	indicator?	no	indicator?	yes	indicator?	no	indicator?	no	indicator?	no
invasive?	no	invasive?	no	invasive?	no	invasive?	no	invasive?	no	invasive?	no
comments		comments	Toxic to livestock	comments		comments		comments	Stabilizer. Uncommon. Fo	comments	
abbreviation	EUPH	abbreviation	FICA	abbreviation	GADI	abbreviation	GULA	abbreviation	HEAN	abbreviation	HECO
genus	<i>Euphorbia</i>	genus	<i>Flago</i>	genus	<i>Geyophytum</i>	genus	<i>Gullena</i>	genus	<i>Helianthus</i>	genus	<i>Hesperostipa</i>
species	spp.	species	<i>californica</i>	species	<i>diffusum</i>	species	<i>lasiophylla</i>	species	<i>annuus</i>	species	<i>comata</i>
subspecies		subspecies		subspecies		subspecies	spp.	subspecies		subspecies	<i>comata</i>
family	<i>Euphorbiaceae</i>	family	<i>Asteraceae</i>	family	<i>Onagraceae</i>	family	<i>Brassicaceae</i>	family	<i>Asteraceae</i>	family	<i>Poaceae</i>
common name	spurge	common name	flago	common name	flago	common name	California mustard	common name	sunflower	common name	needle-and-thread grass
other name	euphorbia, EURPH	other name	herbimpta	other name	geophytum	other name	pink mustard	other name	helianthus	other name	<i>Stipa comata</i> (former na
type plant	forb-sub-shrub	type plant	forb	type plant	forb	type plant	forb	type plant	forb	type plant	grass
growth habit	annual/perennial	growth habit	annual	growth habit	annual	growth habit	annual	growth habit	annual	growth habit	perennial
native?		native?	yes	native?	yes	native?	yes	native?	yes	native?	yes
indicator?	no	indicator?	no	indicator?	no	indicator?	yes	indicator?	no	indicator?	yes
invasive?	no	invasive?	yes	invasive?	no	invasive?	no	invasive?	yes	invasive?	no
comments		comments		comments		comments		comments		comments	

abbreviation	HEGR	abbreviation	HEMI	abbreviation	HETE	abbreviation	HOMU	abbreviation	ISAB	abbreviation	ISAR
genus	<i>Heterotheca</i>	genus	<i>Hemizonia</i>	genus	<i>Heterotheca</i>	genus	<i>Hordeum</i>	genus	<i>Isocoma</i>	genus	<i>Isomais</i>
species	<i>grandiflora</i>	species	spp.	species	spp.	species	<i>murinum</i>	species	<i>acradema</i>	species	<i>arbores</i>
subspecies		subspecies		subspecies		subspecies	<i>leporinum</i>	subspecies	<i>bracteosa</i>	subspecies	
family	<i>Asteraceae</i>	family	<i>Asteraceae</i>	family	<i>Asteraceae</i>	family	<i>Poaceae</i>	family	<i>Asteraceae</i>	family	<i>Capparidaceae</i>
common name	telegraph weed	common name	tarweed, tar plant	common name	telegraph plant, golden as	common name	Mediterranean barley	common name	goldenbush	common name	bladderpod
other name		other name	hemizonia	other name	heterotheca	other name	hordeum, HOLE	other name		other name	isomais
type plant	forb	type plant	forb	type plant	forb	type plant	grass	type plant	sub-shrub	type plant	shrub
growth habit	annual	growth habit	annual	growth habit	annual/perennial	growth habit	annual	growth habit	perennial	growth habit	annual
native?	yes	native?	yes	native?	no	native?	no	native?	yes	native?	no
indicator?	yes	indicator?	no	indicator?	yes	indicator?	yes	indicator?	no	indicator?	no
invasive?	no	invasive?	no	invasive?	no	invasive?	no	invasive?	no	invasive?	no
comments		comments		comments		comments		comments		comments	soil stabilizer, slope mix
abbreviation	HIIN	abbreviation	HOMG	abbreviation	HOML	abbreviation	JUBU	abbreviation	LAAM	abbreviation	LACA
genus	<i>Hirschfeldia</i>	genus	<i>Hordeum</i>	genus	<i>Hordeum</i>	genus	<i>Juncus</i>	genus	<i>Lamium</i>	genus	<i>Lasthenia</i>
species	<i>incana</i>	species	<i>murinum</i>	species	<i>murinum</i>	species	<i>bulbosus</i>	species	<i>amplexicaule</i>	species	<i>californica</i>
subspecies		subspecies	<i>gluticum</i>	subspecies	<i>leporinum</i>	subspecies		subspecies		subspecies	
family	<i>Brassicaceae</i>	family	<i>Poaceae</i>	family	<i>Poaceae</i>	family	<i>Juncaceae</i>	family	<i>Lamiaceae</i>	family	<i>Asteraceae</i>
common name		common name		common name		common name	load rush	common name	dead nettle	common name	goldfields
other name	hirschfeldia	other name		other name		other name	small juncus	other name	lamium	other name	<i>Lasthenia chrysostoma</i>
type plant	sub-shrub	type plant	grass	type plant	grass	type plant	grass-like	type plant	forb/sub-shrub	type plant	forb
growth habit	perennial	growth habit	annual	growth habit	annual	growth habit	annual	growth habit	annual	growth habit	annual
native?	no	native?	no	native?	no	native?	yes	native?	no	native?	yes
indicator?	yes	indicator?	yes	indicator?	yes	indicator?	yes	indicator?	yes	indicator?	yes
invasive?		invasive?	no	invasive?	no	invasive?	no	invasive?	no	invasive?	no
comments		comments		comments		comments		comments		comments	

abbreviation	LACL	abbreviation	LAPU	abbreviation	LASE	abbreviation	LEPI	abbreviation	LES
genus	<i>Lasthenia</i>	genus	<i>Lamium</i>	genus	<i>Lactuca</i>	genus	<i>Lepidium</i>	genus	<i>Lesq</i>
species	<i>glabrata</i>	species	<i>purpureum</i>	species	<i>seriola</i>	species	spp.	species	spp.
subspecies		subspecies		subspecies		subspecies		subspecies	
family	<i>Asteraceae</i>	family	<i>Lamiaceae</i>	family	<i>Asteraceae</i>	family	<i>Brassicaceae</i>	family	<i>Aste</i>
common name	goldfields	common name	purple dead nettle	common name	prickly lettuce	common name	peppergrass, pepperwort	common name	
other name	<i>Lasthenia glabrata</i>	other name	<i>lamium purpureum</i>	other name	<i>Lactuca pulchella</i> (errone)	other name	lepidium	other name	lessi
type plant	forb	type plant	forb	type plant	forb	type plant	forb	type plant	sub-
growth habit	annual	growth habit	annual	growth habit	annual	growth habit	annual	growth habit	annu
native?	yes	native?	no	native?	no	native?		native?	yes
indicator?	yes	indicator?	yes	indicator?	no	indicator?	no	indicator?	
invasive?	no	invasive?	no	invasive?	no	invasive?	no	invasive?	
comments		comments		comments		comments		comments	
abbreviation	LAST	abbreviation	LEDI	abbreviation	LENI	abbreviation	LITT	abbreviation	LOM
genus	<i>Lasthenia</i>	genus	<i>Lepidium</i>	genus	<i>Lepidium</i>	genus	<i>Lepidium</i>	genus	<i>Lolium</i>
species	spp.	species	<i>dictyotum</i>	species	<i>rubrum</i>	species		species	<i>multu</i>
subspecies		subspecies		subspecies		subspecies		subspecies	
family	<i>Asteraceae</i>	family	<i>Brassicaceae</i>	family	<i>Brassicaceae</i>	family		family	<i>Poa</i>
common name	goldfields	common name	peppergrass, pepperwort	common name	peppergrass, pepperwort	common name	litter	common name	litter
other name		other name	lepidium	other name	lepidium	other name		other name	rye g
type plant	forb	type plant	forb	type plant	forb	type plant		type plant	grass
growth habit	annual	growth habit	annual	growth habit	annual	growth habit		growth habit	annu
native?	yes	native?		native?	yes	native?		native?	no
indicator?	no	indicator?	no	indicator?	no	indicator?		indicator?	no
invasive?	no	invasive?	no	invasive?	no	invasive?		invasive?	no
comments		comments		comments	sg&s nix, slope, wet	comments		comments	

abbreviation	LOSS	abbreviation	LOTE	abbreviation	LOTU	abbreviation	LUSP	abbreviation	MALJ
genus	<i>Loelligia</i>	genus	<i>Lolium</i>	genus	<i>Lotus</i>	genus	<i>Lupinus</i>	genus	<i>Malva</i>
species	<i>squarrosa</i>	species	<i>temulerum</i>	species	spp.	species	<i>sparsiflorus</i>	species	spp.
subspecies	<i>squarrosa</i>	subspecies		subspecies		subspecies		subspecies	
family	<i>Caryophyllaceae</i>	family	<i>Poaceae</i>	family	<i>Fabaceae</i>	family	<i>Fabaceae</i>	family	<i>Aster</i>
common name	loelligia	common name	Dandel grass	common name	lotus spp	common name	lupine sparsiflorus	common name	MALC
other name	phlox-like plant	other name	weird annual rye	other name	lotus spp	other name		other name	
type plant	forb	type plant	grass	type plant	forb	type plant	forb	type plant	forb
growth habit	annual	growth habit	annual	growth habit	annual	growth habit	annual	growth habit	ann. c
native?	yes	native?	no	native?		native?	yes	native?	yes
indicator?	no	indicator?	yes	indicator?	no	indicator?	no	indicator?	
invasive?	no	invasive?	no	invasive?	no	invasive?	no	invasive?	
comments		comments	Toxic	comments		comments	Incorred id? Shaller Cro	comments	
abbreviation	LULA	abbreviation	LUMD	abbreviation	LUPI	abbreviation	MAPA	abbreviation	MEAL
genus	<i>Lupinus</i>	genus	<i>Lupinus</i>	genus	<i>Lupinus</i>	genus	<i>Malva</i>	genus	<i>Malva</i>
species	<i>latifolius</i>	species	<i>microcarpus</i>	species	spp.	species	<i>parviflora</i>	species	<i>alba</i>
subspecies	<i>latifolius</i>	subspecies	<i>densiflorus</i>	subspecies		subspecies		subspecies	
family	<i>Fabaceae</i>	family	<i>Fabaceae</i>	family	<i>Fabaceae</i>	family	<i>Malvaceae</i>	family	<i>Faba</i>
common name		common name		common name	lupine	common name	cheeseweed, little mallow	common name	white
other name	<i>lupinus latifolius</i>	other name		other name	lupinus	other name	<i>malva parviflora</i>	other name	white
type plant	forb	type plant	forb	type plant	forb	type plant	forb	type plant	forb
growth habit	annual	growth habit	annual	growth habit		growth habit	annual	growth habit	annu
native?	yes	native?	yes	native?	yes	native?	no	native?	no
indicator?	no	indicator?	yes	indicator?	no	indicator?	yes	indicator?	yes
invasive?	no	invasive?	no	invasive?	no	invasive?	no	invasive?	no
comments		comments		comments		comments		comments	

abbreviation MEOG
genus *Melilotus*
species *officinalis*
subspecies
family *Fabaceae*
common name yellow sweetclover
other name melilotus officinalis
type plant forb
growth habit biennial
native? no
indicator? yes
invasive? no
comments

abbreviation MEPO
genus *Medicago*
species *polymorpha*
subspecies
family *Fabaceae*
common name California burclover
other name *Medicago hispida*
type plant forb
growth habit annual
native? no
indicator? yes
invasive? no
comments

abbreviation MOSS
genus
species
subspecies
family
common name moss
other name
type plant forb
growth habit perennial
native?
indicator?
invasive?
comments

abbreviation NEME
genus *Nemophila*
species *menziesii*
subspecies *menziesii*
family *Hydrophyllaceae*
common name baby blue eyes
other name nemophila
type plant forb
growth habit annual
native? yes
indicator? no
invasive? no
comments

abbreviation NIGL
genus *Nicotiana*
species *glauca*
subspecies
family *Solanaceae*
common name tree tobacco
other name
type plant tree
growth habit perennial
native? no
indicator? yes
invasive? no
comments

abbreviation OLIG
genus *Oligomeris*
species spp.
subspecies
family *Ranunculaceae*
common name
other name Oligomeris
type plant forb
growth habit annual/perennial
native? no
indicator? yes
invasive? no
comments

abbreviation MUSH
genus
species
subspecies
family
common name mushroom
other name mushroom
type plant
growth habit annual
native?
indicator?
invasive?
comments

abbreviation NAHO
genus *Hordeum*
species spp.
subspecies
family *Poaceae*
common name native hordeum
other name native hordeum, HONA
type plant grass
growth habit
native? yes
indicator? no
invasive? no
comments

abbreviation NAPU
genus *Nassella*
species *pukhra*
subspecies
family *Poaceae*
common name purple needlegrasses
other name *Nassella pukhra*
type plant grass
growth habit perennial
native? yes
indicator? no
invasive? no
comments

abbreviation PACA
genus *Panicum*
species *capillare*
subspecies
family *Poaceae*
common name witchgrass
other name panicum cap.
type plant grass
growth habit annual
native? no
indicator? yes
invasive? no
comments

abbreviation PECT
genus *Pectocarya*
species poncillata
subspecies
family *Boraginaceae*
common name
other name Pectocaria
type plant forb
growth habit annual
native? no
indicator? yes
invasive? no
comments Soil stabilizer

abbreviation PHEG
genus *Phacelia*
species *egens*
subspecies
family *Hydrophyllaceae*
common name
other name solanum (sic)
type plant forb
growth habit perennial
native? yes
indicator? no
invasive? no
comments

abbreviation PHPR
genus *Phtem*
species *pratense*
subspecies
family *Poaceae*
common name cultivated timothy
other name Phtem pratense
type plant grass
growth habit perennial
native? no
indicator? yes
invasive? no
comments

abbreviation PHTA
genus *Phacelia*
species *tanacetifolia*
subspecies
family *Hydrophyllaceae*
common name
other name
type plant forb
growth habit annual
native? yes
indicator?
invasive? no
comments n/n, slope, wet mixes

abbreviation PISA
genus *Pisum*
species *sativum*
subspecies
family *Fabaceae*
common name garden pea
other name field pea
type plant forb
growth habit annual
native? no
indicator? no
invasive? no
comments

abbreviation POSE
genus *Poa*
species *secunda*
subspecies
family *Poaceae*
common name one sided Kentucky blue
other name perennial grass, *Poa* scal
type plant grass
growth habit perennial
native? yes
indicator? no
invasive? no
comments

abbreviation PUOC
genus *Puccinellia*
species spp.
subspecies
family *Poaceae*
common name alkali grass
other name puccinellia
type plant grass
growth habit annual/perennial
native? no
indicator? no
invasive? no
comments stabilizer

abbreviation RARA
genus *Raphanus*
species *raphanistrum*
subspecies
family *Brassicaceae*
common name jointed charlock
other name radish
type plant forb
growth habit annual/biennial
native? no
indicator? no
invasive? no
comments purplish flowers

abbreviation PLAG
genus *Plagiobothrys*
species spp.
subspecies
family *Boraginaceae*
common name popcorn flower
other name plagiobothrys
type plant forb
growth habit annual
native? yes
indicator? no
invasive? no

abbreviation POAR
genus *Polygonum*
species *arenastrum*
subspecies
family *Polygonaceae*
common name common knotweed
other name polygonum fasciculatum
type plant forb
growth habit annual
native? no
indicator? yes
invasive? no

abbreviation PCBT
genus *Populus*
species *balsamifera*
subspecies *trichocarpa*
family *Salicaceae*
common name black cottonwood
other name
type plant tree
growth habit perennial
native? yes
indicator? no
invasive? no

abbreviation RASA
genus *Raphanus*
species *sativa*
subspecies
family *Brassicaceae*
common name wild re cultivated radish
other name radish
type plant forb
growth habit annual
native? no
indicator? no
invasive? no
comments yellowish flowers

abbreviation ROCK
genus n/a
species
subspecies
family
common name rock
other name rock
type plant
growth habit
native?
indicator? yes
invasive?

abbreviation SAIR
genus *Salix*
species *fragilis*
subspecies
family *Salicaceae*
common name white willow
other name
type plant tree
growth habit perennial
native? no
indicator? yes
invasive? no

abbreviation SATR
 genus *Salsola*
 species *tragus*
 sub-species
 family *Chenopodiaceae*
 common name Russian thistle, tumble we
 other name *S. kili, australis, ibrico*
 type plant sub-shrub
 growth habit annual
 native? no
 indicator? yes
 invasive? yes
 comments noxious

abbreviation SETA
 genus *Setaria*
 species spp.
 sub-species
 family *Poaceae*
 common name
 other name setaria
 type plant grass
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation SCAR
 genus *Schismus*
 species *arabicus*
 sub-species
 family *Poaceae*
 common name Mediterranean grass
 other name SCAR
 type plant grass
 growth habit annual
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation SEVU
 genus *Senecio*
 species *vulgaris*
 sub-species
 family *Asteraceae*
 common name groundsel, ragwort
 other name *senecio vulgaris*
 type plant forb
 growth habit annual
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation SCBA
 genus *Sisymbrium*
 species *barbatus*
 sub-species
 family *Poaceae*
 common name Mediterranean grass
 other name SCBA
 type plant grass
 growth habit annual
 native? no
 indicator? yes
 invasive? no
 comments n/m m/b

abbreviation SIAL
 genus *Sisymbrium*
 species *altissimum*
 sub-species
 family *Brassicaceae*
 common name tumble mustard, jenn hill m.
 other name *sisymbrium altissimum*
 type plant sub-shrub
 growth habit annual
 native? no
 indicator? yes
 invasive? yes
 comments

abbreviation SIIR
 genus *Sisymbrium*
 species *lira*
 sub-species
 family *Brassicaceae*
 common name London rocket
 other name S. lra
 type plant forb
 growth habit annual
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation SOHA
 genus *Sorghum*
 species *halpense*
 sub-species
 family *Poaceae*
 common name Johnson grass
 other name Johnson grass
 type plant grass
 growth habit perennial
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation SIMA
 genus *Silybum*
 species *maritimum*
 sub-species
 family *Asteraceae*
 common name milk thistle
 other name milk thistle
 type plant sub-shrub
 growth habit annual/biennial
 native? no
 indicator? yes
 invasive? yes
 comments

abbreviation SONC
 genus *Sonchus*
 species spp.
 sub-species
 family *Asteraceae*
 common name sow thistle
 other name sonchus
 type plant forb/sub-shrub
 growth habit annual/perennial
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation SOEL
 genus *Solanum*
 species *elaeagnifolium*
 sub-species
 family *Solanaceae*
 common name white horse nettle, silver
 other name *Solanum ele*
 type plant forb
 growth habit perennial
 native? no
 indicator? yes
 invasive? no
 comments noxious

abbreviation SOOL
 genus *Sonchus*
 species *oleraceus*
 sub-species
 family *Asteraceae*
 common name common sow thistle
 other name sonchus
 type plant forb/sub-shrub
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation SPER
 genus *Spergularia*
 species spp.
 sub-species
 family *Caryophyllaceae*
 common name sand-spurrey
 other name
 type plant forb
 growth habit perennial
 native? no
 indicator? no
 invasive? no
 comments

abbreviation TRFE
 genus *Trifolium*
 species *repens*
 sub-species
 family *Fabaceae*
 common name white clover
 other name white clover
 type plant forb
 growth habit perennial
 native? no
 indicator? yes
 invasive? no
 comments

abbreviation SPIR
 genus *Sporobolus*
 species *airoides*
 sub-species
 family *Poaceae*
 common name alkali sacaton
 other name
 type plant grass
 growth habit perennial
 native? yes
 indicator? no
 invasive? no
 comments

abbreviation TRTE
 genus *Tribulus*
 species *terrestris*
 sub-species
 family *Zygophyllaceae*
 common name puncture vine, catclaw
 other name
 type plant forb
 growth habit annual
 native? no
 indicator? yes
 invasive? yes
 comments Toxic

abbreviation TRFO
 genus *Trifolium*
 species spp.
 sub-species
 family *Fabaceae*
 common name
 other name
 type plant forb
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation TRVU
 genus *Triticum*
 species *vulgare*
 sub-species
 family *Poaceae*
 common name cultivated wheat
 other name *triticum vulgare*
 type plant grass
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments

abbreviation UNCA
 genus
 species
 sub-species
 family *Caryophyllaceae*
 common name
 other name unknown Caryophyllaceae
 type plant forb
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation UNFO
 genus
 species
 sub-species
 family
 common name
 other name unknown forb
 type plant
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation UNCHO
 genus
 species
 sub-species
 family *Chenopodiaceae*
 common name
 other name unknown Chenopod
 type plant forb
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation UNMU
 genus
 species
 sub-species
 family *Brassicaceae*
 common name
 other name unknown mustard; white n
 type plant forb
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation UNCO
 genus
 species
 sub-species
 family *Asteraceae*
 common name unknown composite
 other name unk. composite
 type plant forb
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation UNPL
 genus
 species
 sub-species
 family *Polygonaceae*
 common name unknown polygonaceae
 other name
 type plant
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation UNFO
 genus
 species
 subspecies
 family *Poaceae*
 common name
 other name unknown poaceae
 type plant grass
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation VICI
 genus *Vicia*
 species spp.
 subspecies
 family *Fabaceae*
 common name vetch
 other name vicia
 type plant forb
 growth habit annual/perennial
 native? no
 indicator? no
 invasive? no
 comments

abbreviation UNTR
 genus
 species
 subspecies
 family *Fabaceae*
 common name
 other name unknown trifolium
 type plant forb
 growth habit
 native?
 indicator?
 invasive?
 comments

abbreviation VUMY
 genus *Vulpia*
 species *myuros*
 subspecies *hirsuta*
 family *Poaceae*
 common name
 other name *Festuca myosueta* (former)
 type plant grass
 growth habit annual
 native? no
 indicator? no
 invasive? no
 comments ntn, slope mix

abbreviation VECA
 genus *Veratrum*
 species *californicum*
 subspecies
 family *Liliaceae*
 common name corn lily, false hellebore
 other name HELEHO
 type plant forb
 growth habit biennial
 native?
 indicator? no
 invasive? no
 comments Toxic. Deer Creek mix 31.

Appendix 2. Summary of demonstration projects with cooperators.

Summary of demonstration projects with cooperators.

Cooperator	Project Location	Acreage	Goals
Arvin-Edison Water Storage District	Arvin-Edison Recharge Basin, Kern County	1.00	Wetland levee erosion control and slope stabilization
Bidart Farms	Shafter Check and Lerdo, fencelines, Kern County	1.57	Fenceline weed and pest control
DCTRA - Deer Creek Lower Tule River Authority	Deer Creek, Tulare County	2.00	ROW seeding
Harlan Ranches	East of Clovis on Tollhouse Road, Fresno County	1.00	Evaluate native perennials for heavy soils.
Sharp Farms and Ranches	Cartmill Road, Tulare County	1.50	1. Stabilize sump banks for weed control. 2. Orchard cover crop for weed control.

Appendix 3. Seed mixes used on the demonstration projects.

Proposed seed mixes for the demonstrator plots.

SPECIES	COMMON NAME	SEED MIX PERCENT				
		Arvin-Edison Pond	Bidart Farms	Deer Creek	Harlan Ranch	Sharp Ranch
Achillea millefolium var. californica	California white yarrow	4		4	6	6
Achnatherum hymenoides var. paloma (aka Oryzopsis h.)	Indian ricegrass		12		10	
Agrostis exarata	spike bentgrass		12	8		
Baccharis viminea	mulefat	3		4		
Bromus arizonicus/carinatus	Arizona/California brome	8	12	7	10	12
Castilleja exserta (aka Orthocarpus purpureus)	purple owl's clover			4		12
Clarkia purpurea	purple clarkia			4		6
Dichelostemma capitatum (aka Brodiaea pulchella)	blue dicks, wild hyacinth			4	6	6

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SPECIES	COMMON NAME	SEED MIX PERCENT				
		Arvin-Edison Pond	Bidart Farms	Deer Creek	Harlan Ranch	Sharp Ranch
<i>Distichlis stricta</i> (aka <i>D. spicata</i>)	inland saltgrass	8		7		
<i>Eleocharis macrostachya</i> (aka <i>E. palustris</i>)	spikerush	8				
<i>Leymus glaucus</i> ssp. <i>glaucus</i>	blue wildrye		8		7	
<i>Elymus multisetus</i> (aka <i>Sitanion elymoides</i>)	big squirreltail		8	6	7	
<i>Eriogonum fasciculatum</i> var. <i>foliolosum</i> or <i>polifolium</i>	California flat top buckwheat			2	3	
<i>Hordeum brachyantherum</i> ssp. <i>brachyantherum</i> or <i>californicum</i>	meadow barley	9	12	8		11
<i>Juncus effusus</i>	common, pacific or soft rush	8				
<i>Juncus xiphioides</i>	flat bladed, iris or ivy leaved rush	9				
<i>Krascheninnikovia lanata</i> (aka <i>Ceratoides l.</i>)	winterfat				4	

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SPECIES	COMMON NAME	SEED MIX PERCENT				
		Arvin-Edison Pond	Bidart Farms	Deer Creek	Harlan Ranch	Sharp Ranch
<i>Lasthenia californica</i> (aka <i>L. crysostoma</i>)	dwarf goldfields			4	6	6
<i>Leymus triticoides</i> (aka <i>Elymus t.</i>)	beardless or creeping wildrye	9	12	7		12
<i>Lupinus bicolor</i>	miniature or pygmy leaved lupine			4	6	6
<i>Lupinus microcarpus</i> var. <i>densiflorus</i> or <i>horizontalis</i>	chick or golden lupine			4	6	6
<i>Lupinus polyphyllus</i>	blue pod, bush or Russell lupine	3		2		
<i>Lupinus succulentus</i> (aka <i>L. sparsiflorus</i>)	arroyo lupine				3	
<i>Melica californica</i>	California melic or onion grass				10	
<i>Puccinellia nuttalliana</i> or <i>P. simplex</i>	Nuttall's alkali grass		12	7	10	

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SPECIES	COMMON NAME	SEED MIX PERCENT				
		Arvin-Edison Pond	Bidart Farms	Deer Creek	Harlan Ranch	Sharp Ranch
Salix exigua	coyote or sandbar willow	3		2		
Scirpus acutus var. occidentalis	bullrush or common hardstem tule	9				
Solidago californica	California goldenrod			4	6	5
Sporobolus airoides	alkali sacaton	9	12	8		12
	TOTAL PERCENT	100	100	100	100	100

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Appendix 4. Quantitative sampling data and analysis.

Statistical analyses of quantitative data

Field data collected annually from test plots was entered into statistical spreadsheets employing Minitab 10 Extra®. Each spreadsheet delineated plant species by acronym, transect, percent cover, and plot site.

Site data was analyzed for five broad based parameters:

- 1) Native grass
- 2) Native species
- 3) Pervasive weeds
- 4) Total cover:
 - a) Shrubs
 - b) Forbs
 - c) Grass
 - d) Total vegetative cover
- 5) Presence of seeded species versus annual weedy species

Chi square tests were executed for each parameter at all sites. Analysis of variance (ANOVA) tests were administered for all categories having more than one species. Statistical significance was noted with percent level of confidence drawn following results if 85% or greater confidence level was recognized. Percent total cover composition for each of the five parameters was mathematically computed using total species numbers determined by chi square tests. Seeded species compared with annual weedy species weighed the ratio of seeded native/naturalized mix success with presence of annual weeds.

Interpretation of tables

Acronyms underneath column headings represent names of plant species identified at the site. Numbers listed for each year under every column denote the total percentage of plants in the category noted for that growing season.

site:	Alta East						
	native grasses	native species	pervasive weeds	shrubs	forbs	grass	total cover
	HECO	AMME	CESO	ERFA	AMME	AVFA	
		CAEX	LASE		CAEX	BRHO	
		ERFA	SIAL		CESO	BRRI	
		HECO	SIMA		ERCI	HECO	
		HETE			HETE	LOTE	
		LAST			LASE	PACA	
		LUPI			LAST	TRVU	
					LUPI	VUMY	
					MELI		
					MEPO		
					SIAL		
					SIMA		
					UNCO		
					VICI		
1996	0.03%	2.80%	35.90%	0	41.50%	44.90%	86.40%
1997	0.20%	0.60%	48.60%	0.36%	26.80%	71.20%	98.40%
1998	n/a	n/a	n/a	n/a	n/a	n/a	n/a

site:	Alta East	
	(page 2)	
	%native/n-n mix vs. annual weeds	
	AMME	CESO
	CAEX	LASE
	ERFA	MEPO
	HECO	SIAL
	HETE	TRVU
	LAST	
	LUPI	
1996	0.18%	
1997	28.63%	
1998	n/a	n/a

site:	Alta West						
	native grasses	native species	pervasive weeds	shrubs	forbs	grass	total cover
	HECO	AMME	CESO	ERFA	AMME	AVFA	
	LETR	ATPU	LASE		ATPU	BRHO	
		CAEX	SIAL		CAEX	BRRI	
		HEAN	SIMA		CESO	HECO	
		HECO			ERIC	HOMU	
		JUBU			HEAN	JUBU	
		LETR			LASE	LETR	
					MELI	LOMU	
					MEPO	LOTE	
					SEVU	PHPR	
					SIAL	SETA	
					SIMA	TRVU	
						VUMY	
1996	0.01%	5.30%	36.30%	0.84%	54.60%	43.60%	99.04%
1997	2.00%	3.47%	46.84%	3.12%	34.00%	57.17%	94.29%
1998	n/a	n/a	n/a	n/a	n/a	n/a	n/a

site:	Alta West		
	(page 2)		
	%native/n-n mix vs. annual weeds		
	AMME	AMME	
	CAEX	ATPU	
	HEAN	AVFA	
	HECO	BRRI	
	JUBU	CESO	
	LETR	LASE	
		MEPO	
		PHPR	
		SEVU	
		SIAL	
		TRVU	
1996	7.10%		
1997	47.71%		
1998		n/a	

site:	American Avenue North					
	native grasses	native species	pervasive weeds	shrubs	forbs	grass
	HECO	AMME	BRNI	ERFA	AMME	AVFA
	LETR	COCA	CESO		BRNI	BRHO
		EPIL	CYDA		CESO	BRMA
		ERFA	LASE		COCA	BRRI
		ERSE	SIAL		EPIL	BRTE
		GADI			ERCI	CYDA
		GULA			ERSE	ECHI
		HEAN			GADI	HECO
		HECO			GULA	LETR
		LETR			HEAN	LOTE
		LOPU			LASE	SOHA
		LUPI			LOPU	TRVU
		LUSP			LUPI	VUMY
					LUSP	
					MEAL	
					MELI	
					MEPO	
					PECT	
					PISA	
					SEVU	
					SIAL	
					UNCO	
					VICI	
1996	9.34%	20.13%	15.61%	6.14%	41.54%	28.85%
1997	11.61%	27.22%	21.54%	10.52%	32.99%	32.43%
1998	data missing	data missing	data missing	data missing	data missing	data missing

site:	American Avenue North	
	(page 2)	
	total cover	%native/n-n mix vs. annual weeds
		AMME BRNI
		COCA CESO
		EPIL ECHI
		ERFA ERCI
		ERSE LASE
		GADI MEAL
		GULA MELI
		HEAN MEPO
		HECO PECT
		LETR PISA
		LOPU SEVU
		LUPI SIAL
		LUSP SOHA
		TRVU
1996	76.80%	280.40%
1997	75.94%	147.61%
1998	data missing	data missing

site:	American Avenue South					
	native grasses	native species	pervasive weeds	shrubs	forbs	grass
	HECO	AMME	CESO	ERFA	AMME	AVFA
	LETR	ARGL	CYDA		ARGL	BRHO
		CAEX	DEPI		BRNI	BRMA
		EPIL	LASE		CAEX	BRRI
		ERFA			CESO	BRTE
		ERSE			CONY	CYDA
		GADI			DEPI	HECO
		GULA			EPIL	LETR
		HEAN			ERCI	LOTE
		HECO			ERSE	PHPR
		HETE			EUMA	SOHA
		LAST			EUPH	TRVU
		LETR			GADI	VUMY
		LOPU			GULA	
		LUPI			HEAN	
		LUSP			HEGR	
					HETE	
					LASE	
					LAST	
					LEPI	
					LOPU	
					LUPI	
					LUSP	
					MELI	
					MEOF	
					MEPO	
					PECT	
					SEVU	
					SONC	
					SPER	
					UNCO	
1996	12.90%	32.96%	31.84%	0.89%	31.42%	29.59%
1997	8.84%	39.20%	38.49%	22.20%	22.00%	37.92%
1998	0.20%	44.31%	17.38%	36.75%	31.52%	31.74%
	down 97.74%	up 13.04%	down 45.16%	up 65.54%	up 43.27%	down 16.3%

[illegible]

site:	Coffee Road East						
	native grasses	native species	pervasive weeds	shrubs	forbs		
	none	AMME	AMRE	ATSE	AMME		
		ATSE	SATR		AMRE		
		CAEX			COCA		
		COCA			CRCO		
		CRCO			EPIC		
		EPIL			EUPH		
		LOSS			MAPA		
					MEAL		
					OLIG		
					SATR		
					SIIR		
					SONC		
					UNCO		
					TRTE		
1996	0.00%	2.77%	31.96%	6.90%	20.31%		
1997	0.00%	3.58%	11.49%	0.21%	38.14%		
1998	0.00%	6.14%	0.00%	0.00%	10.73%		
	no change	up 71.51%	down 100%	down 100%	down 71.87%		

site:	Coffee Road East				
	(page 2)				
	grass	total cover	%native/n-n mix vs. annual weeds		
	AVSA		AMME	AMRE	
	BRMA		ATSE	BRNI	
	BRRI		CAEX	ERCI	
	BRTR		COCA	LASE	
	HOMU		CRCO	OLIG	
	SCHI		EPIL	SATR	
	VUMY		LOSS	SEVU	
				SONC	
1996	4.01%	31.22%	69.75%		
1997	15.14%	54.07%	835.67%		
1998	71.91%	82.64%	6.89%	4.66%	
	up 375%	up 52.84%	ratio down 82.31%		

site:	Coffee Road West						
	native grasses	native species	pervasive weeds	shrubs	forbs		
	LETR	AMME	AMRE	ATSM	AMBR		
		ATSE	SATR		AMME		
		CRCO	SIAL		AMRE		
		EPIL	SONC		BRNI		
		GADI			CHAL		
		HETE			COCA		
		LETR			CRCO		
		LOSS			ERCI		
					GADI		
					HETE		
					LASE		
					MAPA		
					OLIG		
					PHLO		
					SATR		
					SEVU		
					SIAL		
					SIIR		
					SONC		
					TRTE		
					UNCA		
					UNCH		
					UNCO		
					UNFO		
					UNMU		
					UNPL		
1996	0.00%	0.40%	10.58%	1.08%	8.39%		
1997	0.00%	2.59%	4.06%	3.59%	59.53%		
1998	0.01%	2.45%	0.00%	0.00%	43.76%		
	up 100%	down 5.4%	down 100%	down 100%	down 26.49%		

[illegible]

site:	Deer Creek 1					
	native grasses	native species	pervasive weeds	shrubs	forbs	grass
	HECO	AMME	AMBR	ATAR	AMBR	AVFA
	LETR	ASSP	CESO	ATPO	AMME	AVSA
		ATPO	COCA	ATSE	ASSP	BRHO
		ATSE	HEMI	ERFA	CABU	BRMA
		COCA	LAPU		CESO	BRRI
		EPIL	LASE		COCA	BRRU
		ERFA	SEVU		CRCO	BRTE
		ERSE	SIAL		EPIL	HECO
		GADI			EPTO	HOMG
		HECO			ERCI	HOMU
		HETR			ERSE	LETR
		LETR			GADI	TRVU
		LUPI			GAYO	VUMY
					HEGR	
					HEMI	
					LAAM	
					LAPU	
					LASE	
					LAST	
					LEDI	
					LUPI	
					MAPA	
					MELI	
					MEOF	
					MEPO	
					PHTA	
					SEVU	
					SIAL	
					UNCH	
					UNFO	
1996	6.75%	16.49%	14.01%	5.92%	13.74%	22.25%
1997	7.15%	24.36%	27.43%	14.70%	17.15%	46.12%
1998	0.90%	32.81%	0.83%	30.23%	24.72%	74.33%
	down 87.41%	up 34.69%	down 96.97%	up 106%	up 44.14%	up 61.17%

[illegible]

site:	Deer Creek 2					
	native grasses	native species	pervasive weeds	shrubs	forbs	grass
	HECO	AMME	COCA	ATPO	AMME	AVFA
	LETR	ATPO	LASE	ERFA	ATPU	AVSA
		ATPU	SATR		COCA	BRHO
		COCA	SIAL		CONV	BRMA
		ERFA			CRCO	BRRI
		ERSE			EPTO	BRRU
		GADI			ERCI	BRTE
		HECO			ERSE	HECO
		LETR			GADI	HOMU
		PEPO			LASE	LETR
					LAST	TRVU
					LESS	VUMY
					MELI	
					MEOF	
					MEPO	
					PHTA	
					SEVU	
					UNFO	
1996	0.12%	6.79%	7.54%	2.75%	7.20%	37.13%
1997	1.60%	12.03%	16.30%	7.82%	18.38%	54.30%
1998	9.83%	52.33%	2.69%	39.73%	27.38	31.92%
	up 514%	up 4.35%	down 83.5%	up 396%	up 48.97%	down 41.21%

site:	Deer Creek 2		
	(page 2)		
	total cover	%native/n-n mix vs. annual weeds	
		AMME	COCA
		ATPO	CONV
		ATPU	LASE
		ERFA	MEOF
		ERSE	MEPO
		HECO	SATR
		LAST	SEVU
		LETR	SIAL
		PHTA	
1996	47.08%	115.00%	
1997	80.50%	80.00%	
1998	67.89%	52.33%	6.00%
	down 15.66%		ratio up 10.90%

site:	Deer Creek 3						
	native grasses	native species	pervasive weeds	shrubs	forbs	grass	
	HECO	AMME	COCA	ATPO	AMBR	AVFA	
	LETR	ATPO	COAR	ATSE	AMME	AVSA	
		COCA	HEMI	ERFA	ATPU	BRHO	
		EPIL	HETE		COAR	BRMA	
		ERFA	LASE		COCA	BRRI	
		ERSE	MEPO		CROO	BRRU	
		HECO	SATR		EPIL	BRTE	
		LETR	SEVU		ERTP	HECO	
		LUPI	SIAL		ERCI	HOMU	
					ERSE	LETR	
					EUPH	TRVU	
					HEMI	VUMY	
					HETE		
					LASE		
					LAST		
					LOPU		
					LUPI		
					MAPA		
					MELI		
					MEOF		
					MEPO		
					PHTA		
					SEVU		
					SIAL		
					SPER		
1996	4.69%	18.10%	32.73%	12.88%	30.28%	51.52%	
1997	0.25%	17.32%	54.41%	11.86%	29.21%	38.62%	
1998	5.53%	57.27%	0.84%	50.09%	18.80%	58.97%	
	up 2112%	up 231%	down 99.74%	up 322%	down 35.64%	up 52.69%	

site:	Deer Creek 3		
	(page 2)		
	total cover	%native/n-n mix vs.	annual weeds
		ATPO	AMBR
		ATSE	ATPO
		EPIL	
		ERFA	ERIC
		ERSE	HEMI
		HECO	HETE
		LAST	LASE
		LETR	MEOF
		LUPI	MEPO
		PHTA	SATR
			SEVU
			SIAL
1996	94.68%	36.44%	
1997	79.69%	21.91%	
1998	128.11%	59.40%	15.67%
	up 60.76%		ratio up 1630%

site:	Lerdo Non-op					
	native grasses	native species	pervasive weeds	shrubs	forbs	grass
	HECO	ATPO	CHAL	ATPO	AMME	AVFA
	LETR	AMME	LASE	ERFA	AMRE	AVSA
		ERFA		ISAR	CABU	BRHO
		ERSE	SOOL		CHAL	BRMA
		GADI			CHEN	BRRI
		HECO			COCA	BRTE
		ISAR			CRCO	HECO
		LETR			EPTO	HOML
		LUMD			ERCI	HOMU
		LUSP			ERSE	TRVU
		PLAG			GADI	VUMY
					GNAP	
					HETE	
					LASE	
					LUMD	
					LUSP	
					PHTA	
					PLAG	
					SEVU	
					SOOL	
					UNFO	
1996	1.75%	4.12%	38.12%	0.38%	5.32%	93.64%
1997	14.38%	4.24%	48.10%	8.76%	4.37%	72.94%
1998	3.45%	38.38%	1.66%	34.92	2.31	113.88
	down 76.01%	up 805%	down 99.65%	up 299%	down 47.14%	up 56.13%

site:	Lerdo Non-op		
	(page 2)		
	total cover	%native/n-n mix	vs. annual weeds
		ATPO	AMRE
		ERCI	CHAL
		ERFA	ERCI
		HECO	HETE
		ISAR	LASE
		LETR	SEVU
		LUMD	SOOL
		PHTA	TRVU
1996	99.34%	31.46%	
1997	86.07%	201.00%	
1998	151.11%	38.38	2.2
	up 73.57%		ratio up 723%

site:	Lerdo Wet						
	native grasses	native species	pervasive weeds	shrubs	forbs	grass	
	LETR	AMAC	AMBR	ATSE	AMAC	AVFA	
	NAHO	AMME	BRNA	ERFA	AMBR	AVSA	
		ATSE	LASE		AMME	BRHO	
		CRCO	SIAL		BRNA	BRMA	
		EPIL	SOHA		CABU	BRRI	
		ERFA			CHEN	BRTE	
		ERSE			COCA	HOML	
		FICA			CRCO	HOMU	
		GADI			EPIL	LETR	
		ISAB			EPTO	NAHO	
		LAST			ERCI	PUCC	
		LETR			ERSE	SETA	
		LUSP			EUMA	SOHA	
		PHTA			FICA	TRVU	
		PLAG			GADI	UNPO	
					ISAB	VUMY	
					LASE		
					LAST		
					LESS		
					LUSP		
					MAPA		
					PHTA		
					PLAG		
					RASA		
					SEVU		
					SIAL		
					SOOL		
					UNFO		
					UNFR		
					VICI		
1996	12.02%	32.63%	30.10%	5.89%	14.07%	12.83%	
1997	16.56%	18.96%	19.80%	0.00%	5.64%	79.62%	
1998	53.70%	59.04%	1.33%	0.00%	6.43%	126.81%	
	up 224%	up 211%	down 92.58%	no change	up 14.01%	up 59.27%	

site:	Lerdo Wet		
	(page 2)		
	total cover	%native/n-n mix vs. annual weeds	
		AMAC	AMBR
		AMME	ERCI
		CRCO	EUMA
		EPIL	LASE
		ERCI	SEVU
		ERFA	SIAL
		ERSE	SOHA
		ISAB	
		LAST	
		LETR	
		LUSP	
		PHTA	
1996	32.79%	140.00%	
1997	85.26%	95.42%	
1998	133.24%	59.04%	1.25%
	up 56.28%		ratio up 4850%

site:	Orosi							
	native grasses	native species	pervasive weeds	shrubs	forbs	grass	total cover	
	HECO	COCA	BRNI	ERFA	BRNI	AVFA		
	LETR	ERSE	BRRA		BRRA	BRHO		
		HECO	CESO		CESO	BRRI		
		LETR	CONV		COCA	BRTE		
					CONV	HECO		
					EPTO	LETR		
					ERSE	TRVU		
					LASE			
					LAST			
					LOPU			
					MEOF			
1996	18.69%	18.92%	4.19%	0.71%	9.78%	65.79%	76.28%	
1997	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
1998	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

site:	Orosi		
	(page 2)		
	%native/n-n mix vs. annual weeds		
	COCA	BRNI	
	ERFA	BRRRA	
	HECO	CESO	
	LAST	LASE	
	LETR		
1996	475.15%		
1997	n/a		
1998	n/a	n/a	
	n/a	n/a	

site:	Rocky Hill						
	native grasses	native species	pervasive weeds	shrubs	forbs	grass	
		GALI	BRNI		BRNI	AVFA	
		COCA	LASE		COCA	BRMA	
			SATR		EPTO	BRRJ	
			SIAL		ERCI	BRRU	
					GALI	TRTE	
					HIIN	VUMY	
					LAPU		
					LASE		
					MAPA		
					MELI		
					MEOF		
					MEPO		
					SATR		
					SIAL		
					SIIR		
1996	0.00%	0.00%	60.16%	0.03%	55.51%	25.34%	
1997	0.00%	0.00%	41.42%	0.00%	23.22%	62.41%	
1998	0.00%	1.43%	8.56%	0.00%	41.46%	88.01%	
	no change	up 100%	down 79.33%	no change	up 78.55%	up 41.02%	

site:	Rocky Hill		
	(page 2)		
	total cover	%native/n-n mix vs. annual weeds	
		GALI	BRNI
		COCA	ERCI
			LAPU
			LASE
			MEOF
			MEPO
			SATR
			SIAL
			SIIR
1996	80.88%	0.00%	
1997	85.63%	11.05%	
1998	130.48%	1.43%	40.03%
	up 52.38%	ratio down 32.33%	

site:	Shafter Check East Side North Mix						
	native grasses	native species	pervasive weeds	shrubs	forbs	grass	total cover
	HECO	AMME	ATPU	ATPO	AMME	AVFA	
	LETR	ATPO	HETE	ERFA	CABU	AVSA	
	POPR	COCA	LASE	UNSH	COCA	BRMA	
		CRCO			CRCO	BRRI	
		EPIL			EPIL	BRRI	
		ERFA			ERTP	BRTE	
		ERSE			ERIC	HECO	
		FICA			ERSE	HOMG	
		GADI			EUPH	HOMU	
		HECO			FICA	LETR	
		LETR			GADI	POPR	
		LUMD			HETE	SCHI	
		LUSP			LAPU	TRVU	
		POPR			LASE	VUMY	
					LAST		
					LOPU		
					LUMD		
					LUSP		
					MELI		
					MEOF		
					PHTA		
					SEVU		
					SIIR		
1996	76.15%	25.00%	11.64%	3.38%	0.061	26.27%	35.75%
1997	21.10%	44.71%	18.27%	18.24%	11.71%	56.31%	86.26%
1998	23.90%	65.53%	3.28%	37.14%	23.95%	56.43%	117.52%
	up 13.27%	up 46.57%	down 82.05%	up 104%	up 105%	up 1.00%	up 36.24%

site:	Shafter Check East Side North Mix	
	(page 2)	
	%native/n-n mix vs. annual weeds	
	AMME	ATPU
	ATPO	ERCI
	COCA	EUPH
	ERCI	HETE
	ERFA	LAPU
	HECO	LASE
	LAST	MEOF
	LETR	SEVU
	PHTA	
	POPR	
1996	600.00%	
1997	362.52%	
1998	65.12%	19.05%
		ratio down 94.30%

site:	Shafter Check East Side South Mix						
	native grasses	native species	pervasive weeds	shrubs	forbs	grass	
	HECO	AMME	BRNI	ATPO	AMME	AVFA	
	LETR	ATPO	HETE		ASTR	AVSA	
		ATPU	LASE		ATPU	BRHO	
		CAEX	SATR		BRNI	BRMA	
		COCA	SIAL		CAEX	BRRI	
		ORCO	SONC		COCA	BRTE	
		EPIL	SOOL		ORCO	BRRU	
		ERFA	TRVU		EPIL	HECO	
		ERSE			ERTO	LETR	
		HECO			ERCI	SCHI	
		LETR			ERSE	TRVU	
		LUMD			EUMA	VUMY	
		LUSP			EUPH		
		PHTA			HETE		
					LASE		
					LAST		
					LUMD		
					LUSP		
					MELI		
					NEME		
					PHTA		
					SATR		
					SEVU		
					SIAL		
					SONC		
					SOOL		
1996	4.70%	22.13%	7.39%	0.79%	6.87%	17.36%	
1997	1.94%	42.52%	8.07%	3.96%	17.65%	63.10%	
1998	1.73%	59.56	3.30%	39.65%	21.66%	54.32%	
	down 10.82%	up 40.08%	down 59.11	up 901%	up 22.72%	down 13.91%	

site:	Shafter Check East Side South Mix		
	(page 2)		
	total cover	%native/n-n mix vs.	annual weeds
		AMME	BRNI
		ATPO	EUMA
		COCA	HETE
		CROO	LASE
		EPIL	SATR
		ERFA	SEVU
		ERSE	SIAL
		HECO	SONC
		LAST	SOOL
		LETR	TRVU
		LUMD	
		PHTA	
1996	25.02%	126.64%	
1997	84.71%	109.91%	
1998	115.63%	59.56%	3.45%
	up 36.50%		ratio up 1339%

site:	Shafter Check West North Mix					
	native grasses	native species	pervasive weeds	shrubs	forbs	grass
	HECO	AMME	AMME	ATPO	AMME	AVFA
	LETR	ATPO	ATPU	ERFA	ATPU	AVSA
		COCA	AVFA	SATR	BRNI	BRHO
		ERFA	AVSA		COCA	BRMA
		ERSE	BRNI		CRCO	BRRI
		HECO	BRRI		ERCI	BRTE
		LETR	COCA		ERSE	HECO
		LUPI	HETE		EUPH	HOMU
		LUSP	LASE		GAYO	LETR
			SATR		GNAP	SCBA
			SIAL		HETE	SETA
					LASE	TRVU
					LAST	VUMY
					LEPI	
					LOTU	
					LUPI	
					LUSP	
					MELI	
					PHTA	
					RAPH	
					SEVU	
					SIAL	
					SOEL	
					UNFO	
1996	9.75%	19.49%	2.57%	9.37%	6.99%	55.27%
1997	11.55%	24.44%	8.44%	16.39%	8.18%	.61.12
1998	21.37%	74.03%	3.01%	50.33%	5.95%	79.46%
	up 85.02%	up 203%	down 64.34%	up 207%	down 27.26%	up 17.37%

[illegible]

site:	Shafter Check West South Native/Naturalized						
	native grasses	native species	pervasive weeds	shrubs	forbs	grass	
	SPIR	AMME	CHAL	ATPO	AMME	AVFA	
		ATPO	HETE	ERFA	CAEX	BRMA	
		CAEX	LASE		CHAL	BRRI	
		COCA	MANE		COCA	BRRU	
		CRCO	SATR		CRCO	HOLE	
		EPIL			EPIL	HOMU	
		ERFA			ERCI	SPIR	
		ERSE			ERSE	TRVU	
		GAYO			EUMA	VUMY	
		HEAN			EUPH		
		LAST			GAYO		
		LUMD			HEAN		
		LUSP			HETE		
		PHTA			LASE		
		SPIR			LAST		
					LUMD		
					LUSP		
					MANE		
					MAPA		
					MELI		
					MEOF		
					PHTA		
					SATR		
					SEVU		
1996	n/a	n/a	n/a	n/a	n/a	n/a	
1997	0.00%	13.89%	31.83%	10.53%	6.45%	67.70%	
1998	0.00%	48.40%	2.66%	34.21%	32.70%	53.84%	
	no change	up 249%	down 91.64%	up 225%	up 407%	down 11.91%	

site:	Shafter Check West South Native/Naturalized		
	total cover	%native/n-n mix	vs. annual weeds
		AMME	CHAL
		ATPO	ERCI
		CAEX	EUMA
		COCA	HETE
		ORCO	LASE
		EPIL	MANE
		ERFA	MEOF
		ERSE	SATR
		GAYO	SEVU
		HEAN	SIAL
		LAST	
		LUMD	
		LUSP	
		PHTA	
		SPIR	
1996	n/a	n/a	
1997	84.68%	28.90%	
1998	120.75%	49.83%	17.53%
	up 42.60%		ratio up 884%

Appendix 5. Photographs of some of the 1994-5 and 1996-7 plots.

- Figure 1. Healthy stand of California buckwheat at American Avenue.
- Figure 2. Lupines and clarkia out-compete many annual weedy invasives at Avenue 48/52.
- Figure 3. Stand of meadow barley at Avenue 48/52.
- Figure 4. Stand of Arizona brome at Avenue 48/52.
- Figure 5. Stand of needle-and thread at Shafter Creek West.
- Figure 6. Mixed stand of shrubs and grasses at Shafter Check/winter 1998-9.
- Figure 7. Bladderpod on the slope at Lerdo above the wet mix in early Spring 1999.



Figure 1. Healthy stand of California buckwheat at American Avenue.



Figure 2. Lupines and clarkia out-compete many annual weedy invasives at Avenue 48/52.

March 26, 1999



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Figure 3. Stand of meadow barley at Avenue 48/52.



Figure 4. Stand of Arizona brome at Avenue 48/52.



Figure 5. Stand of needle-and-thread at Shafter Check West.



Figure 6. Mixed stand of shrubs and grasses at Shafter Check/winter 1998-9.



Figure 7. Bladderpod on the slope at Lerdo above the wet mix in early Spring 1999.

Appendix 6. Qualitative data and analysis of the individual species test plots.

Codes and numeric values for qualitative data and analyses
Vigor and Germination Ratings⁺

Numerical Code	Definition
0	plants do not germinate
1	plants germinate, but die soon without reproducing
2	plants live, but don't reproduce well
3	plants reproduce weakly or only vegetatively
4	plants reproduce
5	plants reproduce very well

⁺ V= vigor and G= germination

Dominance/establishment rating⁺

Numerical Code	Definition
0	plants do not establish
1	trace of plant individuals present
2	small established plant population
3	moderate-sized plant population
4	large-sized plant population
5	species is prominent

⁺ D=dominance; E=establishment

Treatment: Shafter Check/West Side

Scientific Name	1995		1996		1997		1998		Mean	
	D	V	D	V	D	V	D	V		
<i>Distichlis stricta</i>	0	0	0	0	1	1	1	5	.50	1.50
<i>Leymus triticoides</i>	4	4	3	4	3	3	3	4	3.25	3.75
<i>Vulpia myuros</i>	4	4	3	3	4	4	3	5	3.75	4.00
<i>Achnatherum hymenoides</i>	2	4	2	4	2	5	3	5	2.35	4.50
<i>Poa scabrella</i>	4	2	3	3	0	0	0	0	1.75	1.25
<i>Schismus barbatus</i>	4	4	3	4	3	3	2	4	3.00	3.75
<i>Elymus elymoides</i>	0	0	0	0	1	1	0	0	.25	.25
<i>Sporobolus airoides</i>	3	1	0	0	2	2	2	3	1.75	1.50
<i>Nasella cernua</i>	3	2	1	2	1	1	0	0	1.25	1.25
<i>Heterostipa comata</i>	3	4	3	3	4	4	4	5	3.50	4.00

Treatment: Shafter Check/East Side

Scientific Name	1995		1996		197		1998		Mean	
	D	V	D	V	D	V	D	V		
<i>Distichlis stricta</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Leymus triticoides</i>	2	2	2	2	2	5	2	4	2.00	3.25
<i>Vulpia myuros</i>	4	3	3	3	4	5	4	5	3.75	4.00
<i>Achnatherum hymenoides</i>	2	4	--	2	1	2	1	4	1.50	3.00
<i>Poa scabrella</i>	3	4	0	0	0	0	0	0	.75	1.00
<i>Schismus barbatus</i>	4	4	4	4	3	5	3	5	3.50	4.50
<i>Elymus elymoides</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Sporobolus airoides</i>	4	2	0	0	2	2	2	2	2.00	1.50
<i>Nasella cernua</i>	3	2	4	3	0	0	0	0	1.75	1.75
<i>Heterostipa comata</i>	4	5	4	4	4	4	4	5	4.00	4.25

Treatment: Deer Creek

Scientific Name	1995		1996		1997		1998		Mean	
	D	V	D	V	D	V	D	V		
<i>Distichlis stricta</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Leymus triticoides</i>	3	3	3	4	3	5	3	5	3.00	4.25
<i>Vulpia myuros</i>	5	5	4	4	4	5	4	5	4.25	4.75
<i>Acnatherum hymenoides</i>	1	3	1	3	0	0	0	0	.50	1.50
<i>Poa scabrella</i>	3	5	2	2	0	0	0	0	2.25	1.75
<i>Schismus barbatus</i>	4	5	3	3	0	0	0	0	1.75	2.00
<i>Elymus elymoides</i>	3	5	3	3	0	0	0	0	1.50	2.00
<i>Sporobolus airoides</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Nasella cernua</i>	1	3	1	3	0	0	0	0	.50	1.50
<i>Heterostipa comata</i>	3	4	3	4	3	5	4	5	3.25	4.50

Treatment : Orosi

Scientific Name	1995		1996		1997		1998		Mean	
	D	V	D	V	D	V	D	V		
<i>Distichlis stricta</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Leymus triticoides</i>	4	2	3	4	4	5	3	5	3.50	3.75
<i>Vulpia myuros</i>	5	4	3	3	3	3	3	5	3.50	3.75
<i>Achnatherum hymenoides</i>	2	1	0	0	0	0	0	0	.50	.25
<i>Poa scabrella</i>	3	2	0	0	0	0	0	0	.75	.50
<i>Schismus barbatus</i>	4	3	0	0	0	0	0	0	1.00	.75
<i>Elymus elymoides</i>	1	1	1	2	2	1	2	1	1.75	1.25
<i>Sporobolus airoides</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Nasella cernua</i>	2	1	0	0	0	0	0	0	.50	.25
<i>Heterostipa comata</i>	2	2	2	3	4	3	4	5	3.00	3.25

Treatment: American Avenue

Scientific Name	1995		1996		1997		1998		Mean	
	D	V	D	V	D	V	D	V		
<i>Distichlis stricta</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Leymus triticoides</i>	3	4	3	3	1	4	2	5	2.25	4.0
<i>Vulpia myuros</i>	3	3	3	2	4	3	4	3	3.50	2.75
<i>Achnatherum hymenoides</i>	1	2	1	1	0	0	0	0	.50	.75
<i>Poa scabrella</i>	1	1	0	0	0	0	0	0	.25	.25
<i>Schismus barbatus</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Elymus elymoides</i>	2	2	2	2	1	3	1	3	1.5	2.50
<i>Sporobolus airoides</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Nasella cernua</i>	3	3	?	?	1	2	0	0	1.25	1.25
<i>Heterostipa comata</i>	4	4	3	3	4	3	4	5	3.75	3.75

Treatment: Alta/South flats non-op side

Scientific Name	1995		1996		1997		1998		Mean	
	D	V	D	V	D	V	D	V		
<i>Distichlis stricta</i>	0	0	0	0	0	0	0	0	0.00	0.00
<i>Leymus triticoides</i>	1	1	0	0	0	0	0	0	.25	2.25
<i>Vulpia myuros</i>	2	1	2	2	2	2	3	3	2.50	2.00
<i>Oryzopsis hymenoides</i>	1	1	0	2	0	0	0	0	.50	.75
<i>Poa scabrella</i>	0	0	0	2	0	0	0	0	0.00	0.00
<i>Schismus barbatus</i>	0	0	0	2	0	0	0	0	0.00	0.00
<i>Elymus elymoides</i>	0	0	0	2	0	0	0	0	0.00	0.00
<i>Sporobolus airoides</i>	0	0	0	2	0	0	0	0	0.00	0.00
<i>Stipa cernua</i>	1	1	0	2	0	0	0	0	.25	.25
<i>Heterostipa comata</i>	1	1	0	2	0	0	0	0	.25	.25

Treatment: Alta/North flats (op-side)

Scientific Name	1995		1996		1997		1998		Mean	
	D	V	D	V	D	V	D	V		
<i>Distichlis stricta</i>	0	0	*		0	0	0	0	0	0
<i>Leymus triticoides</i>	0	0			0	0	0	0	0	0
<i>Vulpia myuros</i>	1	2			0	0	0	0	0	0
<i>Achnatherum hymenoides</i>	0	0			0	0	0	0	0	0
<i>Poa scabrella</i>	1	1			0	0	0	0	0	0
<i>Schismus barbatus</i>	0	0			0	0	0	0	0	0
<i>Sitanion hystrix</i>	0	0			0	0	0	0	0	0
<i>Sporobolus airoides</i>	0	0			0	0	0	0	0	0
<i>Nasella cernua</i>	0	0			0	0	0	0	0	0
<i>Heterostipa comata</i>	0	0			2	5	2	5	1.75	1.75

* Plots were accidentally burned from a fire started off-site. As these plots were particularly weedy, this will afford the opportunity to determine if burning for weed control could be a useful practice in this area.

Table . Summary of germination and establishment evaluations for all years.

Species			Species Evaluation					
No.	Scientific Name	Common Name	1996-7		1997-8 ⁺		Mean	
			G	E	G	E	G	E
1	<i>A. speciosa</i>	desert needlegrass	.2	.2	0.0	0.0	.10	.1
2	<i>Agropyron riparium</i>	streambank wheatgrass	2.0	1.5	1.0	1.0	1.50	1.25
3	<i>Aristida purpurea</i>	purple three-awn	2.3	1.8	0.0	0.0	1.15	.90
4	<i>Bromus carinatus</i>	Arizona brome	3.5	2.8	3.0	2.0	3.25	2.40
5	<i>Deschampsia caespitosa</i>	tufted hairgrass	2.7	1.8	.67	.33	1.70	1.10
6	<i>E. glaucus</i>	blue wild rye	2.2	1.7	2.3	3.3	2.25	2.50
7	<i>E. multisetus</i>	big squirreltail	3.0	2.5	0.0	0.0	1.50	1.25
8	<i>Festuca idahoensis</i>	Idaho fescue	2.3	1.7	0.0	0.0	1.15	.85
9	<i>Isocoma linearifolia</i>	goldenbush	0.0	0.0	0.0	0.0	0.00	0.00
10	<i>Hordeum brachyantherum</i>	meadow barley	3.7	2.0	2.0	3.0	2.85	2.50
11	<i>Koeleria cristata</i>	prairie junegrass	3.2	2.8	2.3	2.6	2.75	2.70
12	<i>Krascheninnikovia lanata</i>	winterfat	0.0	0.0	.33	.33	.17	.17
13	<i>Leymus cinereus</i>	Great Basin wild rye	2.2	1.7	0.0	0.0	1.10	.85
14	<i>Melica californica</i>	California melic	3.2	2.8	0.0	0.0	1.60	1.40
15	<i>Muhlenbergia rigens</i>	deergrass	.5	.5	0.0	0.0	.25	.25

⁺ Based on three of original five plot locations. Woodlake and Redbanks plots were overcome by weeds and adversely affected by herbicide residual or other contamination, respectively. The St. John's plot data were still used, although they were sprayed by herbicide and driven on by heavy equipment in muddy weather. These plots were almost completely destroyed following this sampling.

Appendix 7. Shrub density data and analysis.

Location	SHRUB DENSITIES PER PLOT									
	ATPO		ERFA		ISAR		NIGL		POBT	
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998
48/52-East 1	n/a	0	n/a	2	n/a	0	n/a	0	n/a	0
48/52-East 2	n/a	0	n/a	0	n/a	0	n/a	0	n/a	0
48/52-East 3	n/a	0	n/a	3	n/a	0	n/a	0	n/a	0
48/52-East 4	n/a	0	n/a	57	n/a	0	n/a	0	n/a	0
48/52-West 1	n/a	0	n/a	0	n/a	0	n/a	0	n/a	0
48/52-West 2	n/a	0	n/a	0	n/a	0	n/a	0	n/a	0
48/52-West 3	n/a	0	n/a	0	n/a	0	n/a	0	n/a	0
48/52-West 4	n/a	0	n/a	42	n/a	0	n/a	0	n/a	0
Alta East	1	n/a	21	n/a	0	n/a	0	n/a	0	n/a
Alta West	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
American Avenue North	n/a	0	273	209	1	0	0	0	0	0
American Avenue South	1	0	179	194	0	0	0	0	0	0
Coffee Road East	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a
Coffee Road West	0	n/a	0	n/a	0	n/a	0	n/a	0	n/a
Deer Creek 1 (Non -native mix)	11	31	516	994	0	0	0	0	0	0
Deer Creek 2 (Native mix)	47	15	640	767	0	0	0	1	0	0
Deer Creek 3 (Mix plot)	47	83	513	786	0	0	0	0	0	0

Appendix 8. Squirrel burrow density data and analyses.

Ground Squirrel Densities

Location	1997	1998
48/52-East 1	n/a	24
48/52-East 2	n/a	49
48/52-East 3	n/a	60
48/52-East 4	n/a	235
48/52-West 1	n/a	3
48/52-West 2	n/a	4
48/52-West 3	n/a	4
48/52-West 4	n/a	41
Alta East	n/a	n/a
Alta West	n/a	n/a
American Avenue North	n/a	0
American Avenue South	n/a	0
Coffee Road East	0	n/a
Coffee Road West	0	n/a
Deer Creek 1 (Non -native mix)	2	17
Deer Creek 2 (Native mix)	2	4
Deer Creek 3 (Mix plot)	2	15
Lerdo Non-op Slope	0	0
Lerdo Wet	1	0
Rocky Hill	0	n/a
Shafter Check East Side North	0	0
Shafter Check East Side South	0	0
Shafter Check West/North	0	0
Shafter Check West/South	0	0
Total	7	456
Average	0.58	24

Appendix 9. Photographs of some of the demonstration test plots.

Figure 8. 1998/9 fenceline planting that shows pink herbicide application and early germination.

Figure 9. Germination of fenceline planting at Shafter/Check West.

Figure 10. Germination of 1998/9 planting at Deer Creek.

Figure 11. Lack of germination on seeded plots at Arvin-Edison pond due to cold weather or other factors.

Figure 12. Loss of pond slopes and planting at Arvin-Edison.

Figure 13. Early germination of healthy stand at Harlan Ranch near Fresno.

Figure 14. Lupine emerging on sump slope at Sharp Farms and Ranches.



Figure 8. 1998/9 fenceline planting that shows pink herbicide application and early germination.

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Figure 9. Germination of fenceline planting at Shafter Check West.



Figure 10. Germination of 1998/9 planting at Deer Creek.

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Figure 11. Lack of germination on seeded plots at Arvin-Edison pond due to cold weather or other factors.



Figure 12. Loss of pond slopes and planting at Arvin-Edison.



Figure 13. Early germination of healthy stand at Harlan Ranch near Fresno.

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Figure 14. Lupine emerging on sump slope at Sharp Farms and Ranches.



Appendix 10. Suggested Planting Guidelines.

SUGGESTED PLANTING GUIDELINES

These guidelines are based on revegetation test-plots of grasses, forbs and shrubs evaluated primarily on clean farmed areas from plantings that were designed not to be irrigated. Habitat conversion of dense vegetative growth, particularly of aggressive weedy species, will require additional site preparation steps.

1. Select revegetation goal(s), e.g. erosion control, increase of beneficial insect populations, pest reduction, weed control, reduction of chemical use, fire reduction, rangeland or wildlife habitat enhancement. The types of plant species selected may differ depending upon the land use goal(s) selected for a site.
2. Plan seed mix(es) incorporating:
 - a. Revegetation goals
 - b. Species adaptations with regard to soils, climate, genetics
 - c. Maintenance and management constraints
 - d. Nutritional and habitat needs of livestock and/or wildlife
 - e. Cost and availability of seed
3. Prepare site properly:
 - a. Remove or eliminate weeds and other vegetative growth
 - b. Rip soil deeply if it has been compacted, such as on a road or other type of construction site. This is an essential step in arid areas, because what little precipitation that falls is needed for successful plant growth. Soil compaction seriously reduces moisture holding capacity.
 - c. Disk or otherwise scarify the soil surface. Leave the soil surface rough. This creates micro-habitats for seed germination, catching available moisture, and reducing wind and evapo-transpiration.
4. Seeding:
 - a. Use a method of seeding appropriate to the size and location of the site. Although a native seed drill is the best way to seed large areas, some areas may not be safely accessible when attempting to seed with a tractor and a drill on slopes. In a case such as this, normal hydroseeding, hydroseeding with a tackifier, or hand seeding may be used.

b. When drilling mixes, use of a seed drill with agitators and several sized seed boxes is essential. Depth bands that can be set for the shallow depth preferred by most native species is also necessary. Some species, such as Indian ricegrass do best when planted at depth of 2-3." This is not always possible when seeding mixes.

c. When hydroseeding, do not include fertilizer with the seed as it reduces seed viability. Prevent the seed from soaking for any length of time in the hydroseeder.

5. Mulching

a. Use of a high profile mulch in an arid area with less than 10-12" annual precipitation is essential. This type of mulch serves several purposes. It reduces seed depredations, it helps hold moisture and reduce evapo-transpiration, and it reduces weed germination.

b. Types of mulch suggested are those that either will not compete with planted species, or those that are formulated from species that have been planted. Rice straw is most successful. Where precipitation is high enough, wheat straw may germinate. Germination of wheat or oat straw mulch can be "fatal" to establishment of a native seed mix.

c. The best type of mulch would be a weed-free native grass straw or hay of one or more of the species being planted. Straw from certified grass seed fields is wonderful but generally in low supply.

d. Tacking is recommended to hold the mulch in place. Tacking may be accomplished with a crimper or spraying a chemical or organic tackifier from a hydroseeder.

Although no test plots were specifically implemented to evaluate conversion of dense weedy habitats to a new planting, experience was gained relative to that issue. In areas densely vegetated by species such as ripgut brome, it is apparent additional pre-treatment will be necessary to reduce the weed seed bank in the soil. Possible suggestions to try are repeated burning, repeated pre-irrigation (natural or artificial), disking or use of pre- or post-emergent herbicides. The latter approach can be difficult to implement when planting seed mixes that include grasses, forbs, and shrubs.